• DECEMBER 1952 •

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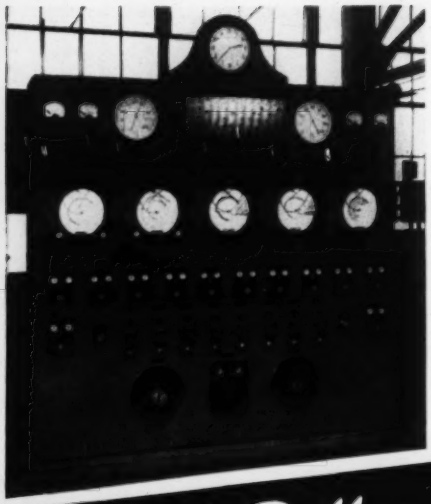

This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

What's Your Control-Dollar Efficiency?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

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For better control-dollar efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-1

BAILEY METERS

BAILEY METER COMPANY

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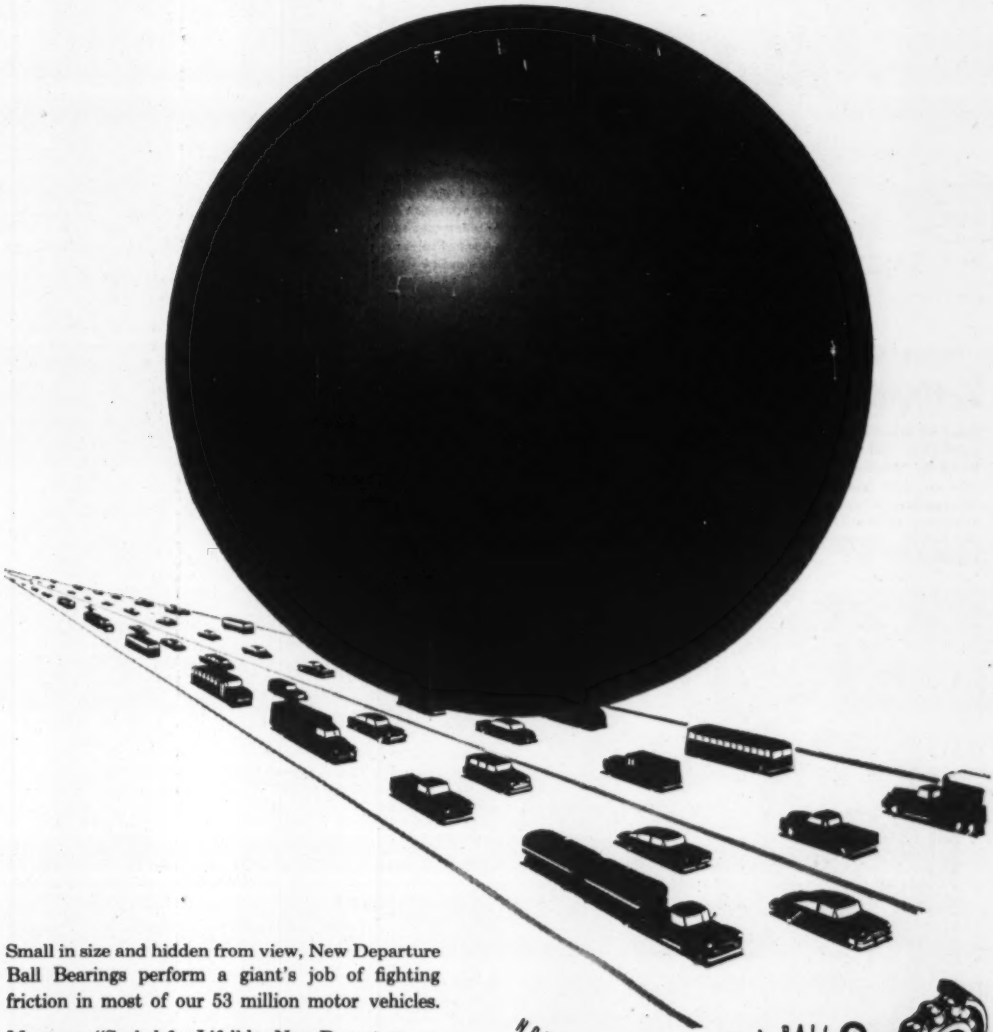
Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

Little Giant of the highway



Small in size and hidden from view, New Departure Ball Bearings perform a giant's job of fighting friction in most of our 53 million motor vehicles.

Many are "Sealed-for-Life" by New Departure . . . installed on fan and water pump shafts, propeller shafts, transmissions and rear wheels. With dirt sealed out and lubricant sealed in, they provide longer wear with less care. N-D-Seal bearings also simplify product design and reduce maintenance.

Through its resources of research . . . its engineering excellence . . . its precision production . . . New Departure is the recognized leader. Keep your eye on the BALL to be sure of your BEARINGS!

NOTHING ROLLS LIKE A BALL

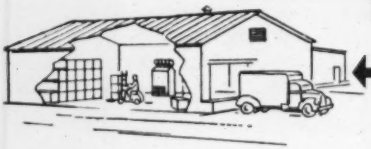
NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, December, 1952, Vol. 74, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢, to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

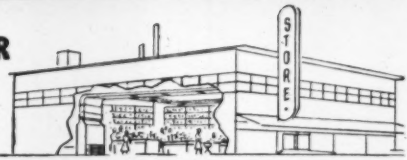
DRAVO *Counterflo*

A POSITIVE *SOLUTION* FOR



1. INDUSTRIAL CENTER

Where space is limited or roof heat losses are unusually high, Dravo Heaters require minimum space . . . no expensive boiler plant; roof heat losses low due to controlled recirculation of air; can be used with or without ducts.

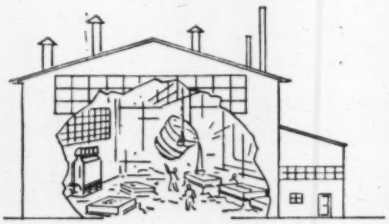


3. SUPERMARKET

In heating, ventilating and air conditioning large areas, Dravo Heaters can tie in with air conditioning system by using same duct work, provide year-'round comfort.

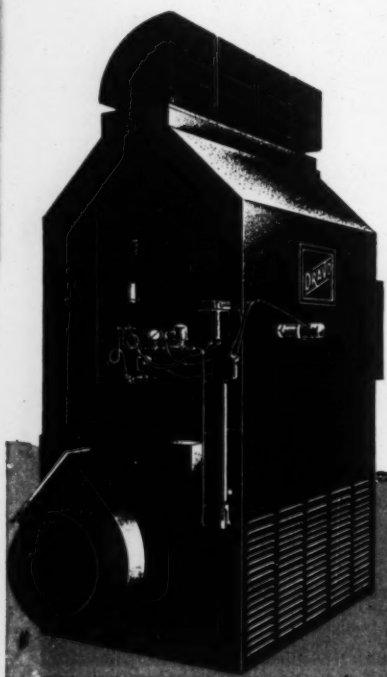
2. FOUNDRY

Negative pressures, caused by exhausting foul air, are balanced by tempering fresh outside air with Dravo Heaters. Atmosphere is kept healthy, constant temperatures are maintained, worker efficiency improves.



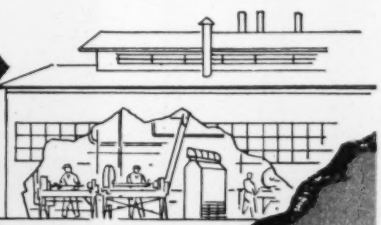
4. MEDIUM-TEMPERATURE CURING

In controlling temperatures and air moisture content in process manufacturing, Dravo Heaters have automatic controls, maintain constant temperature, can recirculate air to control curing process.



5. MACHINE SHOP

For comfort heating large plant areas, Dravo Heaters have maximum air throw in all directions; can be turned off during idle time, warm up quickly, keep fuel costs low, can heat 4,000 to 20,000 sq. ft. area, no duct work required.



Approved by American Gas Association

Listed by Underwriters' Laboratories, Inc.

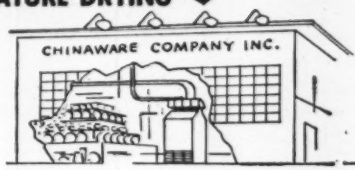
ACCEPTANCE BY FACTORY MUTUAL ENGINEERING DIVISION OF DRAVO STANDARDIZED SAFETY CONTROL CIRCUIT

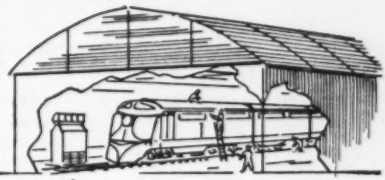
HEATERS.....

8 DIFFERENT HEATING PROBLEMS!

6. MEDIUM-TEMPERATURE DRYING

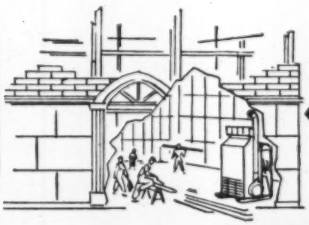
In removing moisture in drying operations, Dravo Heaters provide low-cost heat at even, predetermined temperatures; are automatic in operation, can use gas or oil, are readily converted.





7. TEMPORARY HEATING

For building construction projects where ground temperature must be kept above freezing, Dravo Heaters are quickly installed, easily moved to any location; can be later used as permanent heating plant for the new building.



8. RAILROAD REPAIR SHOP

In providing ample heat for repairmen in large buildings, Dravo Heaters keep heat where it's needed . . . at the working level; directional nozzles easily adjusted to suit conditions; heaters can be mounted on walls or hung from ceiling in any position.

DRAVO *Counterflo* HEATERS CAN SOLVE SIMILAR PROBLEMS IN THESE INSTALLATIONS, TOO

Comfort Heating and Ventilating in schools, churches, auditoriums, laundries, restaurants, garages, factories.

Process Drying of wood, rubber and paint; rug drying; auto laundry operations.

Process Curing of concrete pipe linings, farm crops, paper and fibres.

DRAVO HEATERS OFFER YOU . . .

- Low initial cost—users report 30% to 60% savings.
- Easy installation—electrical, fuel and exhaust connections are only requirements.
- Flexibility—where floor space is limited, can be wall-hung or suspended from trusses.
- Low fuel cost—steam-fluid . . . burn gas or oil . . . units readily converted.
- Automatic operation—on-off or modulating controls.
- Long service life—stainless steel combustion chamber eliminates refractory lining . . . low maintenance costs.

MAIL THIS COUPON FOR MORE INFORMATION . . .

DRAVO

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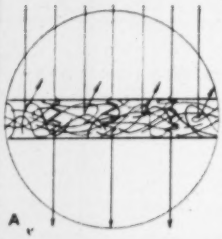
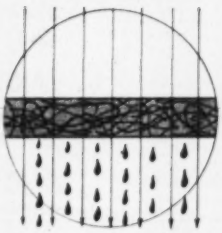
ALBANENE*

TOUGH, LONG-FIBER PAPER
NOT TRANSPARENTIZED



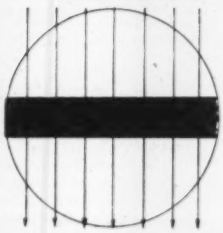
Diagrammatic enlargement of cross section of paper with high strength but low transparency. Fibers are surrounded by air, which has different index of refraction. Many light rays are bent back and do not get through.

SAME PAPER
TRANSPARENTIZED WITH FLUID MATERIAL



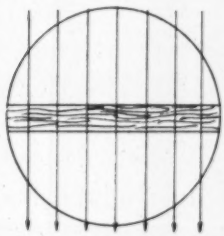
Same paper as "A", filled with oil or other fluid material, giving spaces between fibers same index of refraction as fibers. Reflection and refraction of light are reduced and paper becomes highly transparent. But transparency is not permanent because *fluids* "bleed" out.†

SAME PAPER
TRANSPARENTIZED THE ALBANENE WAY



Same paper as "A", filled with an inert synthetic resin, with correct index of refraction. This is how Albanene is made. Its transparentizer does not "bleed" out. Albanene holds its color and strength and is permanently transparent.†

PAPER TRANSPARENTIZED BY
CRUSHING AND BEATING FIBERS



Papers are also transparentized at the mill by a "beating" process. The fibers are crushed, flattened and compacted. Reflection and refraction of light are reduced. But the process weakens the fibers and the strength of the transparent paper is low.

More than 15 tests are made during production of Albanene. For example, each production roll is tested for pencil "take", for pencil erasing and the taking of drawing ink. To eliminate human variables, pencil lines are drawn by machine. In this way you are assured of the uniformity of working surface so much desired by draftsmen, and assured of a paper that makes cleaner, sharper prints . . . now or a generation later. Ask your K&E Distributor or Branch for further information.

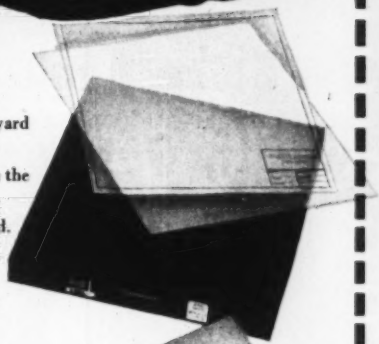
† Prove this by making the "drafting tape test" Press a short piece of drafting tape on fluid-transparentized paper, and another on Albanene. Strip them off the next day and examine both papers. Notice that enough fluid has drifted out of the ordinary paper into the tape to destroy much of the transparency. And notice that Albanene is not affected. What drafting tape does over night, time will do naturally.

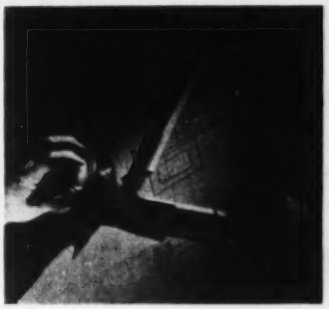
*TRADE MARKS ®

The Right Angle

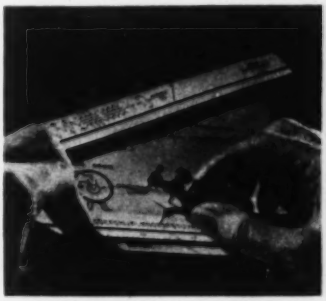
AVAILABLE IN MANY FORMS FOR MANY USES

Albanene comes in 20-yard and 50-yard rolls in various widths and in three different weights. For those who like the convenience of cut sheets, a new Albanene package has been designed. It strongly protects the paper in shipment and storage, and may be opened without mutilating the container, thus serves as a dispenser in drafting room or stock room. Albanene cut sheets can be supplied imprinted to your specifications.





Once you've discovered the pleasure of drawing on Albanene, the next logical step is to save time, trouble and eyesight with a K&E PARAGON* Drafting Machine. You control your calibrated straight edge with a light touch of one hand, for parallel lines and lines at any angle.



Make your lettering letter-perfect and save wear and tear on your nerves by using a LEROY* lettering outfit. Template grooves guide your pen so the finished result looks like printers' type, and the whole process is relaxing. There's a wide choice of sizes, styles and symbols.

K+E

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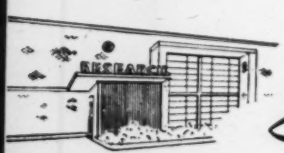
From 1/4" to 16"....Edward Gives You Streamlined Flow in Globe, Angle, Check, Non-Return, Blow-Off, Gate and Feed Line Valves...in Cast and Forged Steel!

In today's trend to higher pressures and temperatures, with resulting increased erosion, streamlined flow plays an even bigger role in keeping valve operating and maintenance costs down . . . and system efficiency high.

Pioneered by Edward—developed after years of extensive flow tests and experiments with plastic models, prototypes, and much specially designed equipment in the largest laboratory in the world devoted exclusively to steel valve research—Edward *Streamlined Flow* offers these four outstanding advantages.

1. **Reduces wear-producing turbulence—giving longer life to seat, disk, and other moving parts.**
2. **Lower pressure drop.**
3. **Delivers maximum flow where needed.**
4. **Often permits use of smaller pipe and valve sizes.**

With Edward's broad range of valve sizes and types with streamlined flow, you can get peak valve operating efficiency . . . all-across-the-board, *wherever* valves are used. *A product of* Edward Valves, Inc., 1350 West 145th Street, East Chicago, Indiana.



Edward ...BIRTHPLACE OF BETTER VALVE DESIGNS

—IN A FULL RANGE OF VALVE SIZES

These illustrations show wear-reducing Edward streamlined flow in both small and large valves. Small valve demonstrates straight through, full flow channel of Edward Univalve. Large valve is Edward globe stop valve . . . note smooth, economical flow pattern.

FEATURES LIKE THIS SAVE YOU MONEY

That's why it pays to specify Edward Valves

Another Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

THIS IS THE **VALVE** THAT

Seals itself

...THAT AUTOMATICALLY ADJUSTS FOR WEAR...

HOMESTEAD-REISER

Self-Sealed...Lubricated

PLUG VALVE

A Homestead-Reiser *acts on its own* to maintain a *drop-tight seal* at all times. It continually and automatically—without manual assistance—adjusts itself to make up for wear as wear occurs.

Its ability to thus effectively seal itself is due to the wedge-action of its two-piece plug which, *under line pressure,* causes the finely finished plug surfaces to constantly press outward to form a perfect seal against the mirror-like bore of the body. A full lubricant seal surrounds the ports and top and bottom of the valve.

Extra-long, leakless service . . . more operations between lubrications—up to 22 times more by actual tests with other well-known lubricated plug valves . . . less maintenance and lower plant operating costs result from their use.

We can furnish them in semi-steel or cast-steel, 100% Port Area or Venturi, in sizes ½" to 14" for steam working pressures to 150 lbs., or oil—water —gas to 200 lbs.

Why not order today and prove them to your own satisfaction.

Complete data and prices will be sent on request. Write today for VALVE REFERENCE BOOK No. 39. No obligation. For local distributor, see Yellow Pages of your Telephone Book.

NOW! AT LOWER PRICES

Sectional View of Full Port Area Homestead-Reiser Valve

Available in Straight-Way and 3-Way—screwed or flanged ends.

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VALVE MANUFACTURING COMPANY

P. O. BOX 38 **CORAOPOLIS, PA.**

Clean-Cutting,
Long-Wearing Cutters that
turn out high production
at top efficiency
The complete line of quality cutters made by Brown & Sharpe is designed to help you get top machine productivity at all times. Their longer wearing qualities mean a longer period of efficient cutting between sharpenings.
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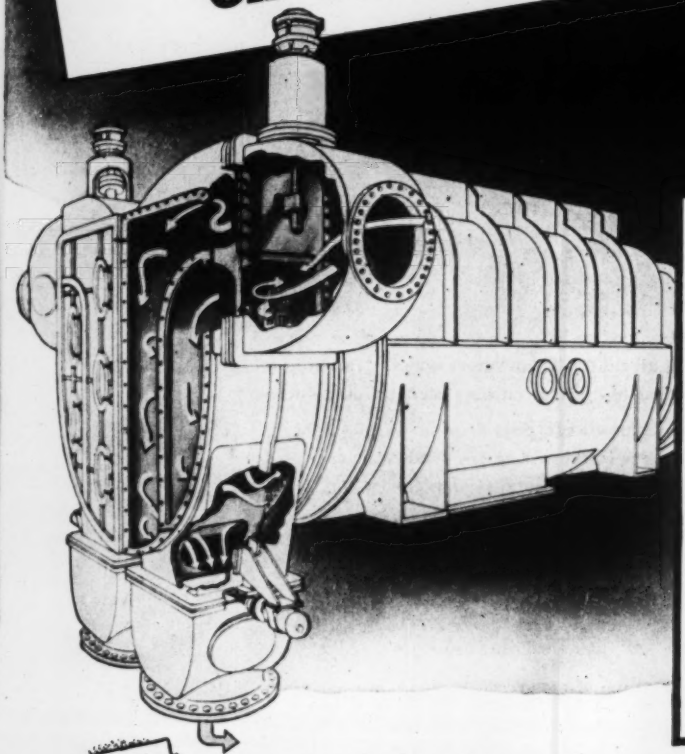
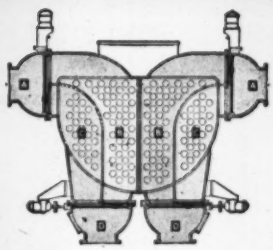
Here's a 3-WAY "ASSIST" On Your Power Plant Problems





HERE IS HOW REVERSE FLOW WORKS

Reverse flow sluice gates on divided water box condensers work the same in both halves but independently of each other. Right side: normal flow. Water enters divided water box in valve chamber "A" with lower port open. It flows through pass "C" to end of condenser, back through pass "B" and out through left port of "D."

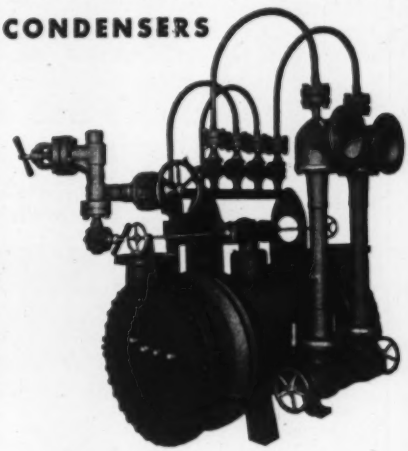
Left side: flow is reversed. Valves at inlet "A" and discharge "D" are changed to permit water to flow through "B" and back through "C" in the opposite direction and then out through the left port of "D."

1 CLEAN DEBRIS FROM CONDENSER TUBE SHEETS WITHOUT DOWNTIME OR LOSS OF VACUUM

C. H. Wheeler "Reverse Flow" Condenser design provides a powerful self-cleaning flushing force by the simple procedure of reversing the flow of water through the tubes. Electrically or hydraulically controlled sluice gates accomplish in minutes cleaning that consumes hours of downtime when removal of debris is done by hand. Power plant modernization calls for the efficiency and uninterrupted operation of C. H. Wheeler "Reverse Flow" Condensers. You don't need costly water straining apparatus. Send for latest bulletin #410.

2 VACUUM PUMPS WITH LOWEST MAINTENANCE FOR YOUR STEAM CONDENSERS

C. H. Wheeler Steam Jet Ejectors are the development of 35 years of pioneering in this field. Known as "Tubejets," these vacuum pumps have no moving parts. Hence, they are simple to operate, require almost no maintenance and last longer. Modern Power plants use single or two-stage Tubejets with surface inter-after condenser for the vacuum requirements of steam condensers. Special arrangements of standard Wheeler ejector assemblies can be provided for any unusual installation or performance requirements. Catalog #1462 gives you detailed descriptions and some useful temperature and pressure conversion tables. Write for it.



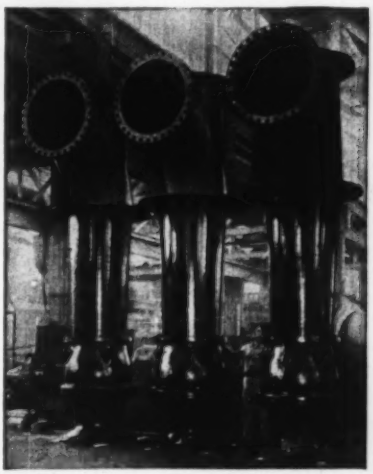
SPECIAL TYPE TUBEJET VACUUM PUMP FOR HIGH PRESSURE AND HIGH SUPERHEAT

3 WHEELER-ECONOMY CIRCULATORS HANDLE LARGER VOLUMES OF WATER AT LOWER COST

Wheeler-Economy Pumps for Condenser Cooling Water Circulation are made in horizontal double suction and vertical submerged, axial mixed flow types. These pumps are noted for reliability, the result of superior modern design and heavy duty, quality construction. They are built in all sizes to meet capacity requirements up to 200,000 GPM. Wheeler-Economy Circulating Pumps are also furnished in special metals to handle corrosive waters. The impellers are designed for satisfactory operation during all load requirements.

Economy engineers are pioneers in the successful application of axial flow pumps in circulator service. These pumps can be furnished in "pull-out" type with distinctive design features, permitting removal of all operating parts, without dismantling the complete pump or disturbing any pipe connections.

For top performance in power plant duty count on Wheeler-Economy Pumps. Write for catalogs #G-349 and G-1050.



THREE CIRCULATORS OF 28,000 G.P.M. CAPACITY. 35 FT. TDH, 575 RPM.

105-R

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Cooling Towers • Vacuum Refrigeration
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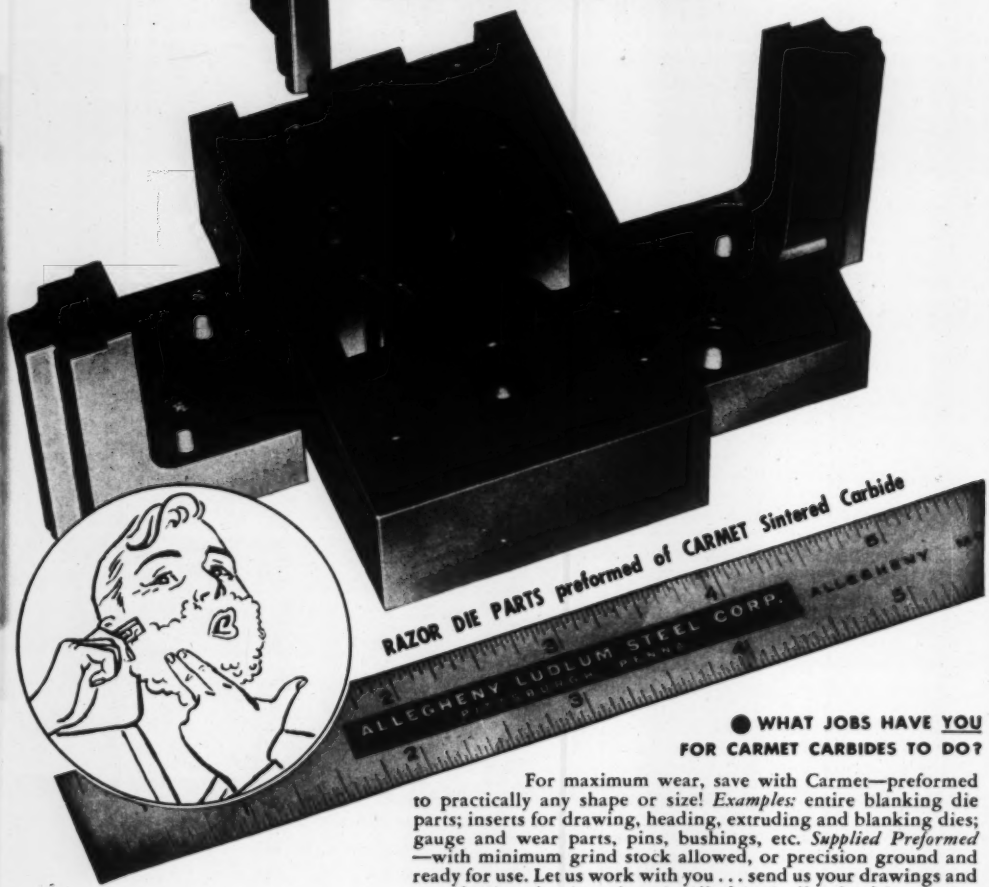
CARMET

can solve *YOUR* *Wear-Resistance* problem



● **WHAT JOBS HAVE YOU FOR CARMET CARBIDES TO DO?**

For maximum wear, save with Carmet—preformed to practically any shape or size! *Examples:* entire blanking die parts; inserts for drawing, heading, extruding and blanking dies; gauge and wear parts, pins, bushings, etc. *Supplied Preformed*—with minimum grind stock allowed, or precision ground and ready for use. Let us work with you . . . send us your drawings and specifications for quotations. ● *Allegheny Ludlum Steel Corporation, Carbide Alloys Division, Wanda and Jarvis Avenues, Detroit 20, Mich.*

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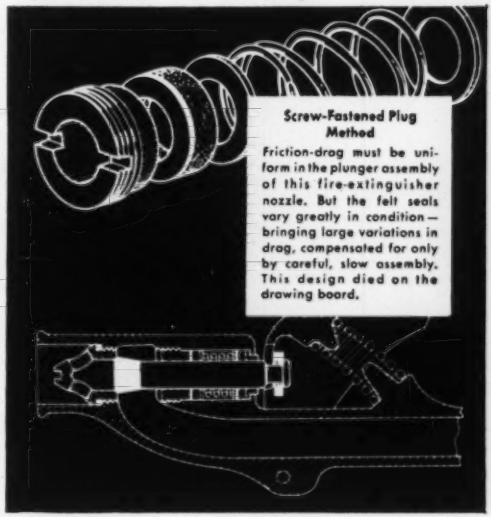
SINCE 1854

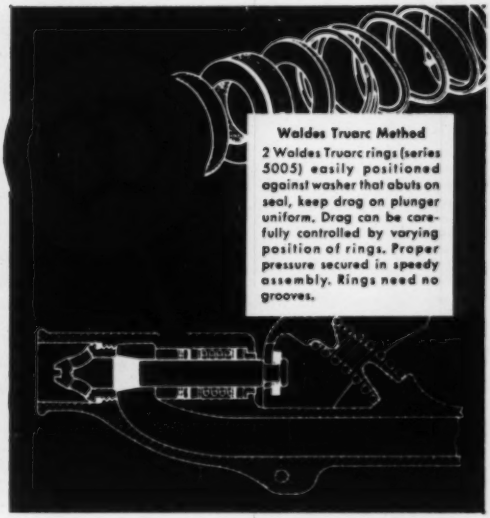
W&D 5488

2 Truarc self-locking rings replace threaded plugs. Save 6¢ per unit, speed assembly by 140%.



Screw-Fastened Plug Method

Friction-drag must be uniform in the plunger assembly of this fire-extinguisher nozzle. But the felt seals vary greatly in condition—bringing large variations in drag, compensated for only by careful, slow assembly. This design died on the drawing board.



Waldes Truarc Method

2 Waldes Truarc rings (series 5005) easily positioned against washer that abuts on seal, keep drag on plunger uniform. Drag can be carefully controlled by varying position of rings. Proper pressure secured in speedy assembly. Rings need no grooves.

Ansul Chemical Company's new watertight precision nozzle for their dry chemical fire extinguisher replaces conventional stainless steel plug with two Waldes Truarc Self-Locking Retaining Rings and washer. Rings hold entire nozzle packing securely in place—keep friction drag of plunger uniform. Adjustable in final assembly, Truarc rings speed production from 25 to 60 units per hour. They save 6¢ per unit in overall costs, 1/8" in length.

Redesign with Waldes Truarc Rings and you, too, will save on assembly, time, improve product performance, facilitate easier servicing of whatever you make.

Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better job of holding parts together. They're precision-engineered... quick and easy to assemble and disassemble. They give a never-failing grip. Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

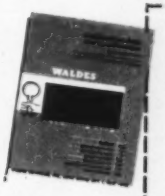
WALDES TRUARC RINGS MADE THESE SAVINGS POSSIBLE—

Discarded Design		Truarc Design	
Parts:	Cost Per Unit	Parts:	Cost Per Unit
threaded stainless steel plug	$0.0675	2 rings	$0.0146
Direct Labor	$0.0350	1 washer	$0.0280
	$0.1025		$0.0426

Total savings per unit with Truarc Rings $.0599

For precision internal grooving and undercutting... Waldes Truarc Internal Grooving Tool.

SEND FOR NEW CATALOG



WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,410,852; 2,420,921; 2,420,341; 2,439,785; 2,441,946; 2,455,165; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog. ME 12-4

(Please print)

Name_____

Title_____

Company_____

Business Address_____

City_____ Zone____ State_____

Why not compress ammonia this new way?

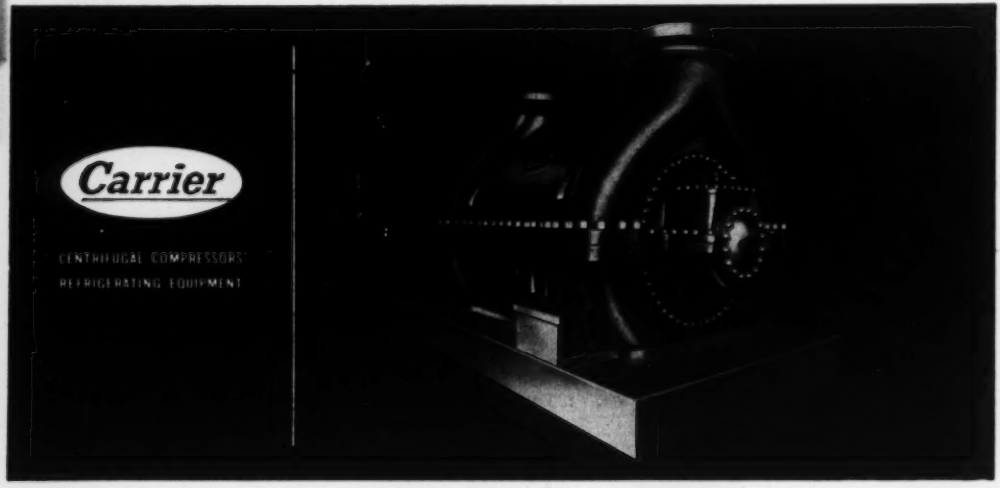
Here's a new idea in ammonia compression. Do it with a Carrier Centrifugal Compressor.

You'll be able to handle more capacity in less space, at lower cost, with far less maintenance.

All-ferrous construction is standard on Carrier Centrifugal Compressors. Nothing need be changed to make them suitable for handling ammonia.

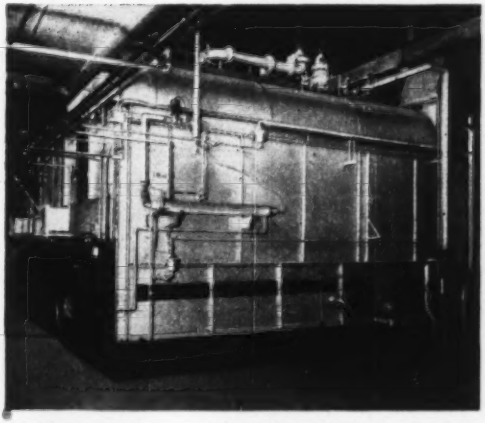
You can let Carrier Centrifugal Compressors handle the whole compression job. Or you can boost your capacity by connecting them with your existing reciprocating equipment.

Either way you can depend on Carrier to do the job right. Carrier has been making centrifugal compressors for 30 years. In that time, they have built over 2500 multi-stage centrifugals—far more than any other manufacturer. Carrier Centrifugal Compressors have handled more different gases than any other make, too. That's an example of the application skill that can pay off for you. Want more information? Write Carrier Corporation, Syracuse, New York.



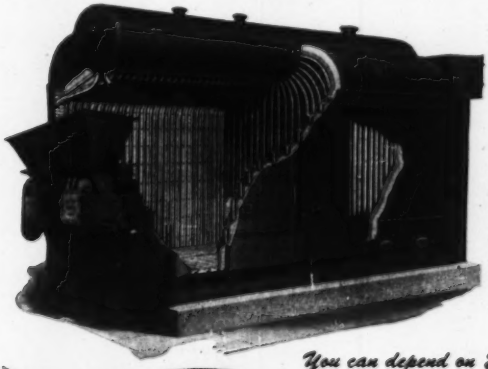
Carrier Centrifugal Compressors, serving the leaders of world industry, are available in standard designs of from 2000 to 40,000 cfm, with from 3 to 7 wheels.

3 Erie City VL's Pay Off in 18 Months at Kaiser-Frazer



Above: Battery of 3 Erie City "VL's"—oil and gas fired—that replaced 7 obsolete coal fired units at a Detroit plant of Kaiser-Frazer Corporation.

Below: Sectional view of standard factory-assembled Erie City "VL" boiler with Erie City spreader stoker. Available for all firing methods.



Before modernization of the E. Jefferson Avenue Detroit plant of Kaiser-Frazer, seven coal fired boilers dating from 1911 and 1920 were in service. The new power plant consists of 3—20,000 pounds per hour Erie City "VL's" for oil and gas firing. They supply steam for heating and process.

While the cost of steam, using coal, would be about 5 cents less per thousand pounds, the use of oil and gas reduced capital investment due to the elimination of new coal storage and allied equipment. Average boiler efficiency of the 3 new Erie City "VL" boilers is 81.5%. Power house labor was reduced from 14 to 6 men. The combined savings from greater efficiency, minimum maintenance and reduced labor costs is expected to pay for the new boiler installation in 18 months.

Are you wasting fuel dollars with worn out boilers? Let Erie City engineers recommend steam generators that will pay for themsleves out of savings.

20 Page Catalog describing Erie City "VL's" in detail shows its easy adaptability to all firing methods and illustrates its superior design features. "VL's" are factory assembled to 300 hp. and field erected in larger sizes. Ask for Bulletin SB-43A.

You can depend on Erie City for sound engineering

ERIE CITY
112 Years in Steam Generation

ERIE CITY IRON WORKS • Erie, Pa.

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

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and INSTRUMENTATION

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Hagan Engineers have developed automatic control equipment and instruments which can be assembled into coordinated systems designed to meet your particular requirements. For example:

HAGAN AIR-OPERATED AUTOMATIC CONTROL EQUIPMENT includes pressure measuring and control units which may be combined into automatic control systems for process industries, metallurgical furnaces and steam power plants.

HAGAN RING BALANCE FLOW METERS are the most versatile meters available. Hagan Meters indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available to measure pressure differentials from 20" to 140" WC at static pressures up to 15,000 psig, and from 40" to 420" WC at static pressures to 2000 psig.

THE SPECIAL APPLICATION DIVISION is equipped to design and fabricate force measuring devices and coordinated control and metering systems for aeronautical testing facilities, and for automotive and process plants. Examples include automatic control of simulated flight conditions in supersonic wind tunnels and altitude test chambers, control systems for gas turbines, thrust stands for full power test of planes, dynamometer testing and automatic batch weighing.

WRITE, WIRE or PHONE today for information about how Hagan Engineers can help you solve your industrial control and instrumentation problems.

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BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AERONAUTICAL
AND AUTOMOTIVE TESTING FACILITIES

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It Takes MORE than a Collection of Parts

To Make A VICKERS CUSTOM BUILT POWER UNIT

A Vickers Custom Built Power Unit is much more than a collection of parts . . . just as the machines you build are more than the castings, shafting, gears, motors, etc. that go into them.

The Vickers Unit is designed and built with the "know-how" obtained during more than a quarter century of experience in practically every kind of hydraulic operation, plus a thorough understanding of your needs. It is built exactly to your individual requirements. All necessary pumps, valves, intermediate piping, oil reservoir, motors, controls, etc., are in one compact and self-contained "package". It includes all needed hydraulic accessories such as oil filters, air cleaners, oil level gauges, fittings, etc. Hydraulic connections may be grouped in a conveniently located manifold.

The result is simplification of hydraulic design and important savings in installation and maintenance costs. Vickers undivided responsibility for the entire hydraulic control system is another important advantage to both the machine builder and his customer. • Write for new Bulletin 52-45.

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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Dun & Bradstreet HAS HIGH COMFORT STANDARDS

Uses "Buffalo" FANS

in unusual high-pressure small-duct ventilation systems

•

"Almost from the first, the equipment and systems worked exactly as they were intended to . . ." from OFFICIAL BULLETIN, Heating, Piping and Air Conditioning Contractors National Association. Below are shown "Buffalo" high pressure fans on the 12th floor. All photos, courtesy Kerby Saunders, Inc.

Above, Dun & Bradstreet Building, New York City: Reinhard, Hofmeister & Walquist, Architects; Syska & Hennessy, Inc., Consulting Engineers; George A. Fuller Co., General Contractor; and Kerby Saunders, Inc., Air Conditioning Contractors.

Occupants of this ultra-modern building enjoy man-made air comfort every day in the year, and behind this comfort are seven large high-pressure "Buffalo" Fans which propel conditioned air to all parts of the building. Yet, gone are the traditional large air ducts, and in their place, small pipes. These save valuable space, yet carry large volumes of air, because the "Buffalo" Fans are forcing it through faster and at higher pressure, QUIETLY! It's a relatively new concept of air delivery, and a hard job for ventilating fans, yet these "Buffalo" Limit-Load Fans are equal to it. Their non-overloading characteristic makes it impossible to burn out a drive motor, no matter how the system pressure varies.

What is *your* job for air? "Buffalo", with its complete line of proven air handling units and its 75 years of experience in air, is ready to help you get the best possible results, as it has helped Dun & Broadstreet and many other well-known firms.

75

FIRST FOR FANS

"Buffalo" BUFFALO FORGE COMPANY

148 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

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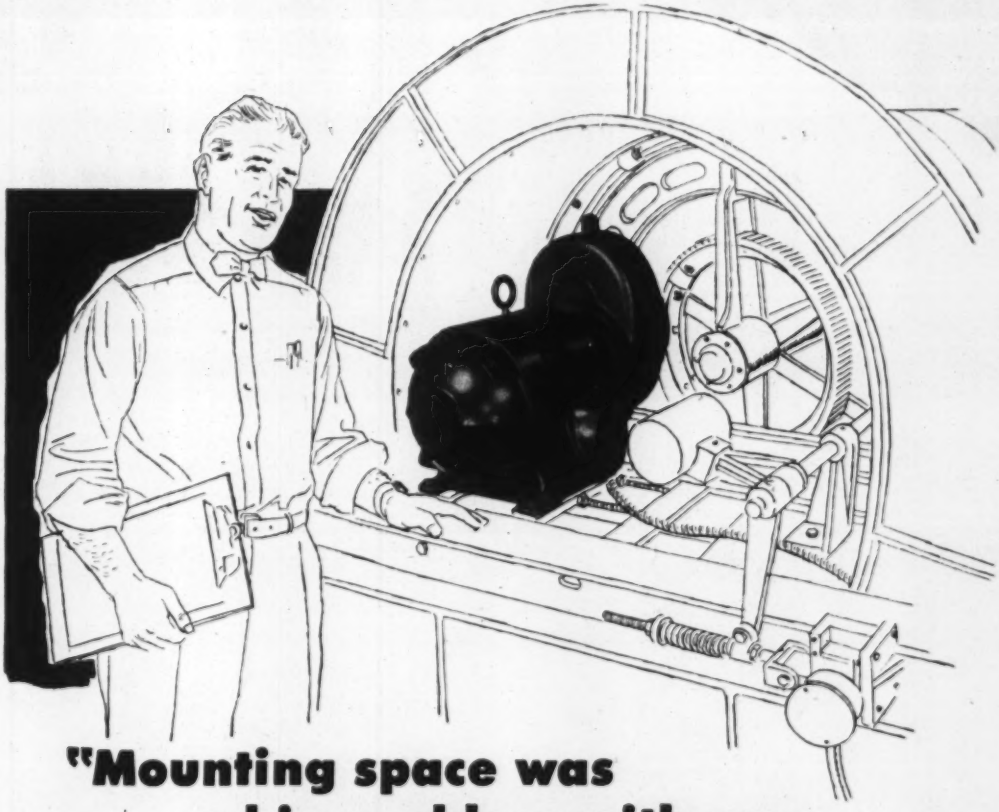


"Mounting space was a big problem with us— now we use Life-Line GEARMOTORS"

"There isn't much space left for mounting a geared drive by the time we squeeze in all the other components of this machine. We find that an integral-type gearmotor is a must and that a Life-Line Gearmotor, in particular, offers the best solution.

"These Life-Line Gearmotors take up less space than any other form of drive we have tried, such as: chains, belts, open gears or coupled speed reducers.

"Whenever we have a speed reduction drive problem we call in the local Westinghouse representative for consultation. I'm sure you'll find his assistance valuable also."

For complete descriptive literature on Life-Line Gearmotors, write to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-07314

Possible applications for FIBERFRAX fiber

THERMAL INSULATION

- Used loose, bonded, packed, or as a blanket for insulating furnaces, jet engines, etc.
- Tape for wrapping pipes and other parts requiring high temperature insulation.
- Fireproofing for safes and containers.
- Packing for expansion joints, kiln ears, etc.
- As a paper, fire curtain, or bonded into a fire wall.

REINFORCING AGENT

- To reinforce electrical insulators, battery plates, etc.
- As a base for sprayed-on ceramic coatings.
- With resins to produce fiber-plastic materials.
- With deposited metals to make porous structures.
- In brake linings.

AS A FILTER

- To filter gases (can be burned clean and reused).
- Filtration of liquids (oils, acids, etc.).
- Plastic filter to remove ash (as in gas turbine).

MISCELLANEOUS

- As a wick or other capillary body.
- Cushioning or vibration dampening material.
- Bonded into acoustical tiles.
- As a diffusing material (high corrosion resistance).
- As a catalyst support.
- For dielectric materials.

This listing does not represent all possible uses. These are simply suggested applications, many of which are untried.

versatile ceramic fiber — insulates, makes superfine filter, resists 2300°F (and more)!

This cotton-like material is a ceramic fiber, a new synthetic with a host of interesting possibilities. Brand new, this remarkable fiber (trademarked FIBERFRAX) easily withstands 2300 F without loss of properties, and up to 3000 F without melting — temperatures far higher than possible with existing mineral or glass fibers. Applications already tested range from — use as a superfine filter (even fine enough to filter bacteria) — to insulating blankets for combustion and exhaust systems of jet engines — to dielectric papers (with electrical losses ¼ those of Kraft paper).

FIBERFRAX fiber is made by melting aluminum oxide and silica (both non-critical materials) at 3300 F. The molten mix is then poured and blasted with an air jet. Instantly, a mass of fluffy white fibers is formed. These fibers are as long as 3", yet average only 4 microns in diameter (about 1/25 the diameter of a human hair). Weight, as blown, is just 2 lbs per cu ft.

This random mass of fibers has many talents. Experimentally, it has been bonded into batts, made into felted rolls or blankets, and even made in paperlike forms (such as tape). When packed to density of about 6 lbs per cu ft, it can make a better heat insulator for many furnaces than high grade insulating brick. Because of its pronounced capillary qualities, it seems suitable for use as a wick. FIBERFRAX fiber is also virtually impervious to most acids. It could be used as a catalyst carrier. And it seems a natural substitute for asbestos — or it could be combined with this rather critical material.

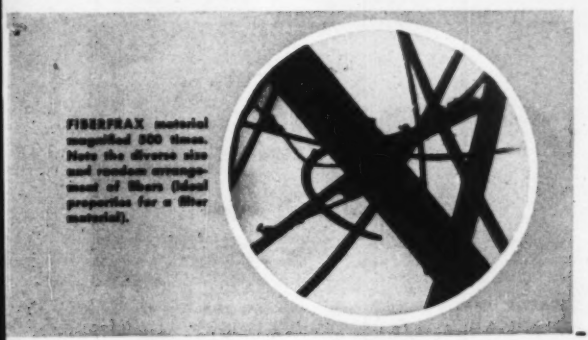
Inherently an excellent electrical insulator, FIBERFRAX fiber will find many dielectric applications. It also lends itself to use as a reinforcing agent — for example, in battery plates, or in low pressure laminates, or perhaps as a base for sprayed on ceramics. It is resilient and makes a good cushioning or packing material, particularly for high temperature spots. It could be used for fire proofing, or bonded into a firewall. FIBERFRAX tiles also deaden sounds. In bulk or paper form it makes an unparalleled filter for gases, liquids, flames, etc.

Do any of these applications suggest possibilities to you? If so, please write or phone us. Though FIBERFRAX fiber is presently available only in bulk form, all the forms mentioned here (and perhaps others) will soon be commercially available. Why not check up now?

CARBORUNDUM

Trade Mark

"Carborundum" and "Fiberfrax" are trademarks which indicate manufacture by The Carborundum Company



FIBERFRAX material magnified 500 times. Note the diverse size and random arrangement of fibers (ideal properties for a filter material).

FOR COMPLETE INFORMATION — USE THIS COUPON

Dept. P-122, Refractories Division
The Carborundum Co., Perth Amboy, N. J.

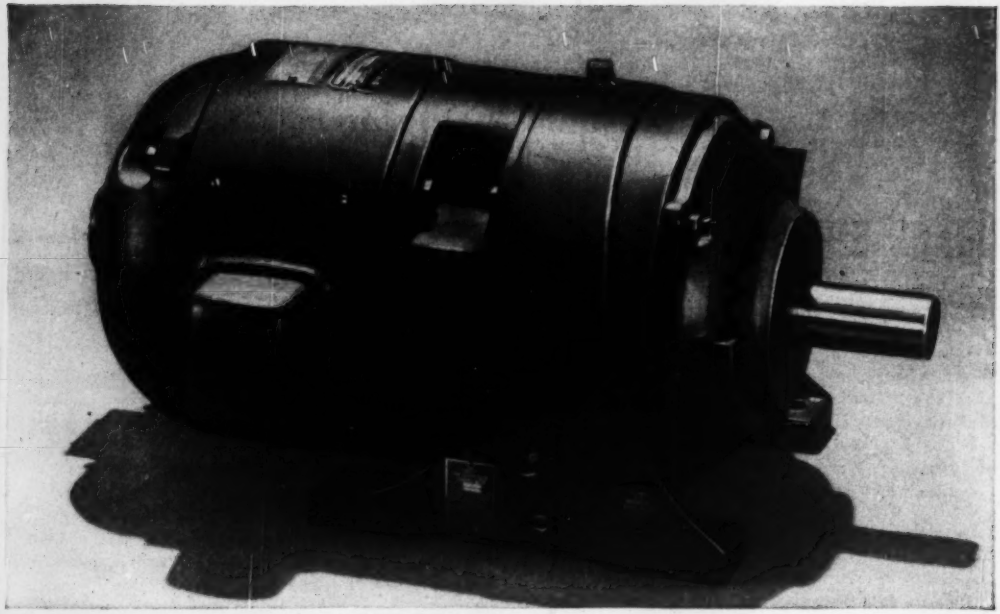
Please send free folder on FIBERFRAX fiber.

Name_____

Position_____ Company_____

Street_____

City_____ Zone____ State____



G.E. Announces Improved Gear-motor Design

Maintenance costs and time cut more than 50% by new gear-motor

General Electric's improved gear-motor is a single unit —a superior low-speed drive, now redesigned to further reduce maintenance costs. Here's how!

STATOR REMOVAL may now be accomplished without disturbing the gear train in any way. Simply remove the endshield, the four bolts which secure the stator, and pull off the stator. Because this is part of the complete line of *standard* G-E motors, you can use *any* G-E motor stator of the same size as a replacement.

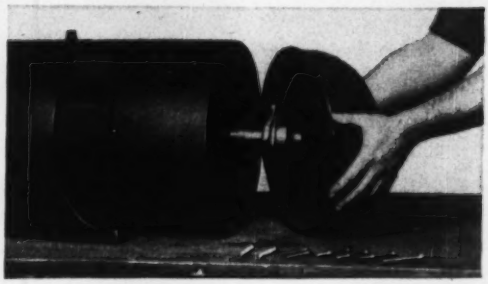
TRI-CLAD* MOTORS—the most reliable, most widely-accepted motors available—are now an integral part of *every* G-E gear-motor, either open or totally enclosed. All open gear-motors have dripproof construction.

PROMPT SHIPMENT is made possible by G.E.'s new stocking plan, which keeps popular ratings stocked at multiple points throughout the country. In addition, over 250 models are now on a one-week shipping schedule from the factory.

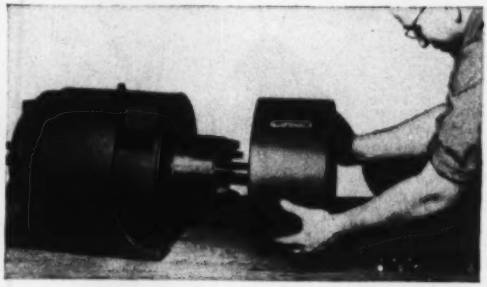
G-E gear-motors, being single units, are easier to install and maintain than motors coupled to separate, external gear reducers. They're available in standard enclosures to fit any application. Order your G-E gear-motor through your nearest G-E Apparatus Sales Office, or your Authorized G-E Agent or Distributor. General Electric Company, Schenectady 5, N. Y. 733-9

*Reg. trade mark of General Electric Co.

GENERAL ELECTRIC



ENDSHIELD REMOVAL is a simple matter. Remove the bearing-cap and endshield bolts, and lift the endshield from the stator.



STATOR REMOVAL now consists of just removing the four stator bolts and slipping the stator from the gear-motor housing.

Main steam piping at Salem Harbor Station of New England Power, 1000° F and 1450 psi, supported by Grinnell Constant Support Hangers.

Problem:

PIPING THAT GROWS...

Solution:

GRINNELL ENGINEERED HANGERS

Eight . . . nine . . . ten inches of thermal deflection! That's not a bit uncommon in today's high temperature, high pressure systems. Very hard-to-come-by, though, is the skill necessary for dealing successfully with suspension problems resulting from *"piping that grows"* . . .

Large manufacturing facilities, expert technicians, and a lot of down-to-earth practical knowledge are needed.

Grinnell is America's No. 1 supplier of pipe hangers and supports, because Grinnell combines modern manufacturing with expert background knowledge gained during a century of piping specialization. Grinnell has developed hangers and supports for *every* piping need, from the simplest to the most complex. Grinnell, and Grinnell alone, can offer these advantages:

- Complete "start-to-finish" production facilities—including research, design, manufacturing, engineering and field service.
- Practical experience in every type of piping gained during the past 100 years.
- Coast to coast distribution—enabling "out of stock" purchases, anywhere.

Grinnell is always ready to cooperate with engineers and architects in the preparation of pipe suspension specifications. Call Grinnell for pipe hangers and supports.

GRINNELL MODEL L CONSTANT SUPPORTS maintain full safety factor in high temperature, high pressure systems. 3 physical structures accommodate maximum travel requirement of 2½, 5 and 10 inches; 16 sizes collectively cover numerous load ranges between 121 and 19,530 lbs.

GRINNELL PRE-ENGINEERED SPRING HANGERS— maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes. 16 sizes available from stock — load range from 74 lbs. to 9000 lbs.

GRINNELL VIBRATION CONTROL AND SWAY BRACES— dampen vibration, oppose pipe sway and absorb shock. 3 sizes give full deflection forces from 200 to 1800 lbs.; have initial precompressed spring forces from 50 to 450 lbs. respectively.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

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Breweries
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Electrical Equipment
Electric Power
Food Products
Foundries
Gas Works
Gelatine
Glass
Hosiery
Knitting Mills
Institutions
Laundries
Leather
Linoleum
Locomotive
Lumber
Machinery
Metal Producing
Mining
Municipal
Oil Refining
Paint
Paper
Public Utilities
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Sugar
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U. S. Government

Industries follow

In industry after industry, you'll find leading companies are setting the pace for efficient, reliable steam production with C-E Vertical-Unit Boilers.

The Chemical Industry is a typical example. For VU Boilers have been purchased by most of the major manufacturers in this industry, including such nationally-known leaders as those shown in the list below.

Furthermore, chemical manufacturers, both large and small, have *proved* their satisfaction with Vertical-Unit Boilers by buying them again and again. In 1951, for example, more than 60 per cent of the VU capacity ordered by chemical companies represented repeat order business. One leading manufacturer, in fact, has purchased twenty-seven units during the past twelve years — *eleven of them in 1951!*

You can profit from the experience of the Chemical Industry — as from any industry where steam for power or process is of major importance. If you use steam, investigate the lower steam costs you can get through the advanced design . . . sound construction . . . proved reliability of VU Boilers. They are available in capacities to fit your needs—from 10,000 to 350,000 pounds of steam per hour.

Typical List of Chemical Companies that have purchased VU Boilers for one or more plants

Air Reduction Co., Inc.
Allied Chemical & Dye Corp.
Atlas Powder Co.
Carbide & Carbon Chemical Corp.
Colgate-Palmolive-Peet Co.
Diamond Alkali Co.
E. I. du Pont de Nemours & Co., Inc.
B. F. Goodrich Chemical Co.
Hercules Powder Co.
Merck & Co., Inc.
National Distillers Chemical Co.
Pennsylvania Salt Mfg. Co.
Pittsburgh Coke & Chemical Co.
Charles Pfizer & Co.
Shell Chemical Co.
U. S. Industrial Chemicals Co.

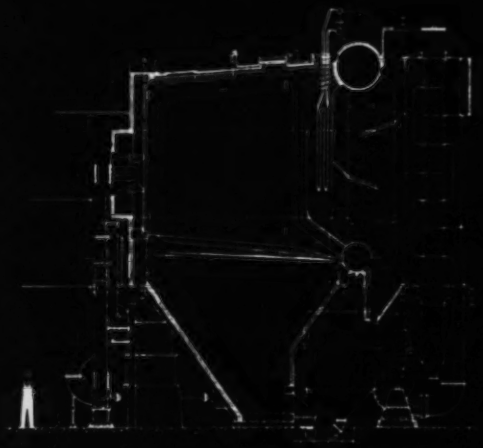
C-E

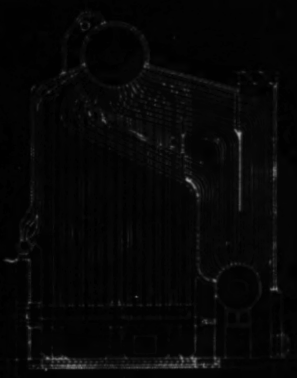
COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL

VU

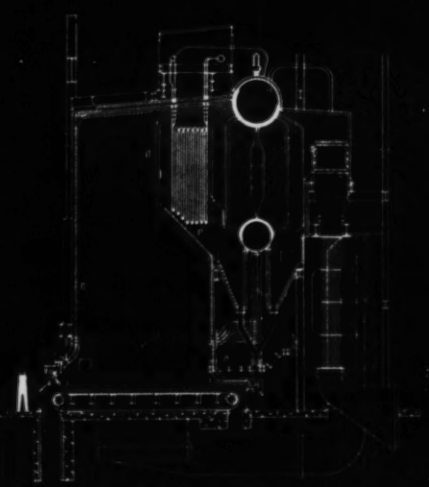




1 VU-50 BOILER installed in Midwestern plant. This boiler is fired with pulverized coal using C-E Raymond Bowl Mills. The capacity is 65,000 lb of steam per hr. Steam pressure is 400 psi — steam temperature is 600 F.

2 VU-10 BOILER fired with oil. Installed in an Eastern plant, the boiler's capacity is 15,000 lb of steam per hr at 250 psi and 480 F. VU-10 capacities range from 10,000 to 60,000 lb of steam per hr. They may also be fired by spreader, underfeed or chain grate stokers.

3 VU-40 BOILER installed in a large Southern plant. This unit is fired by coal, using C-E Spreader Stokers (continuous discharge type). Capacity of this boiler is 150,000 lb of steam per hr at a pressure of 900 psi and a temperature of 808 F.



How Do YOU Score on

How do the drives from the power source in the machines you design score in this "driving" test?

	YES	NO
1. Do they transmit power positively and efficiently without costly slippage?	☐	☐
2. Do they assure positive, precise timing of machine operations . . . constant maintenance of speed ratios?	☐	☐
3. Do they have maximum shock absorbing ability?	☐	☐
4. Do they require only infrequent, low-cost, easy maintenance?	☐	☐
5. Are they compact . . . do they transmit large horsepower in limited space?	☐	☐
6. Are they sturdy and reliable . . . do not fail suddenly . . . will take abuse in emergencies?	☐	☐
7. Can they be lubricated for long life . . . are not affected by oil or grease?	☐	☐
8. Are they not affected by static electricity . . . free from fire hazard caused by overheating?	☐	☐
9. Are they the quietest medium obtainable in operation . . . free from vibration?	☐	☐
10. Are they simple to install and replace?	☐	☐
11. Are they long lived . . . of all-metal construction?	☐	☐
12. Do they allow for variations in shaft setting?	☐	☐
13. Are they free from pre-loads that shorten shaft bearing life?	☐	☐
14. Are they free from power loss, regardless of adjustment?	☐	☐

To find out how your drives rate, see opposite page.

This "Driving" Test?

Score seven points for every "Yes" answer. How did your drives make out? If you scored from 84 to 98 points, your drives are excellent, you're using the best drives for your machines.

You're using chain drives.

If you scored from 64 to 83 points, your drives are probably in good shape, but you'd better check them over for possible improvements in chain application.

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U·S·S Carilloy steel springs soak up

Alloy springs cushion tremendous mechanical shocks in 200-ton short-circuit generators ...save expense of forgings

In testing high-voltage circuit breakers, engineers at General Electric Company *intentionally* short-circuit two huge motor-driven generators. Each of these test generators is normally rated 125,000 kva, but provides short-circuit currents as high as 182,000 amp, instantaneous, offset wave, corresponding to about 1,625,000-kva rms symmetrical short-circuit duty. Such operation causes tremendous mechanical stresses to build up inside each machine. These stresses create a torque that tries to twist loose the 200-ton stator assembly. But no damage is done! These powerful machines are mounted on U·S·S CARILLOY steel plate springs that cushion the shock and then damp out any vibrations that follow.

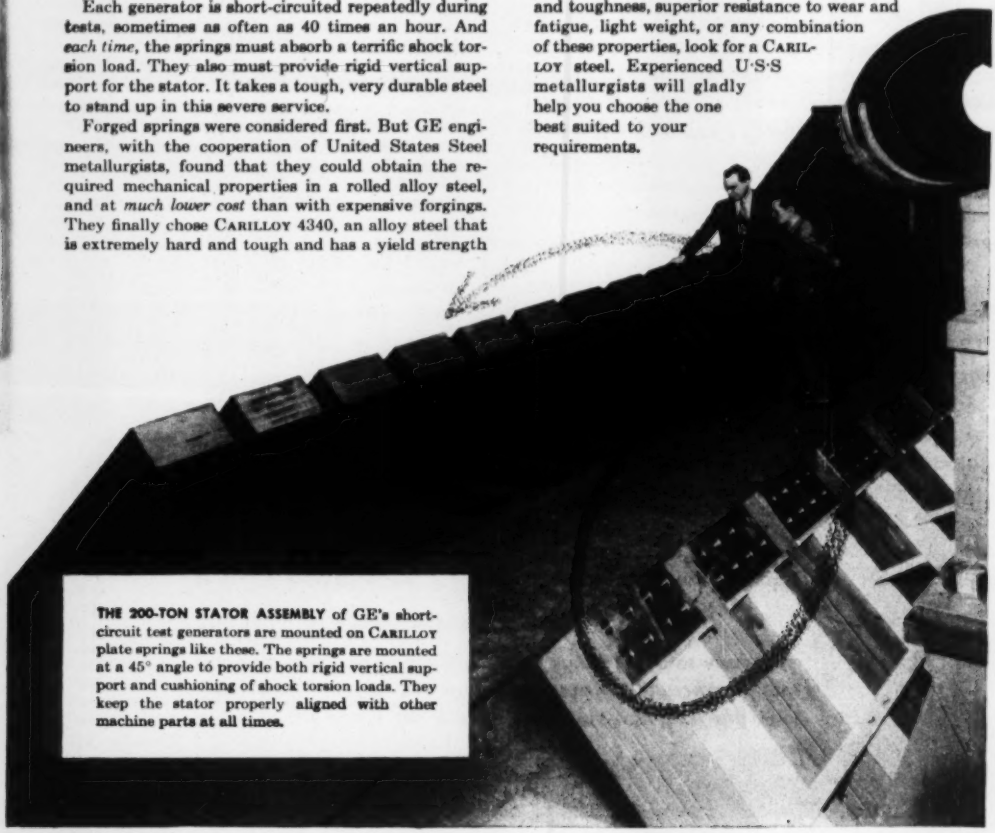
Each generator is short-circuited repeatedly during tests, sometimes as often as 40 times an hour. And *each time*, the springs must absorb a terrific shock torsion load. They also must provide rigid vertical support for the stator. It takes a tough, very durable steel to stand up in this severe service.

Forged springs were considered first. But GE engineers, with the cooperation of United States Steel metallurgists, found that they could obtain the required mechanical properties in a rolled alloy steel, and at *much lower cost* than with expensive forgings. They finally chose CARILLOY 4340, an alloy steel that is extremely hard and tough and has a yield strength of about 100,000 psi. This insures good endurance at 40,000 psi as required in this rugged application.

Also important was the fact that CARILLOY 4340 is easy to heat treat. Plates were furnished to GE quenched, tempered, and special cut and stress relieved.

This steel is giving excellent service. Initial vertical displacement of each generator was only 0.35 mils. Under the most severe short circuit, developing a whopping *8 million lb. ft.* of torque, frame rotation is about ½ in. each way at the point of attachment of the springs. The axial centerline of the machine stays within 30 mils of its normal position. These movements are sufficient to cushion the shock effectively.

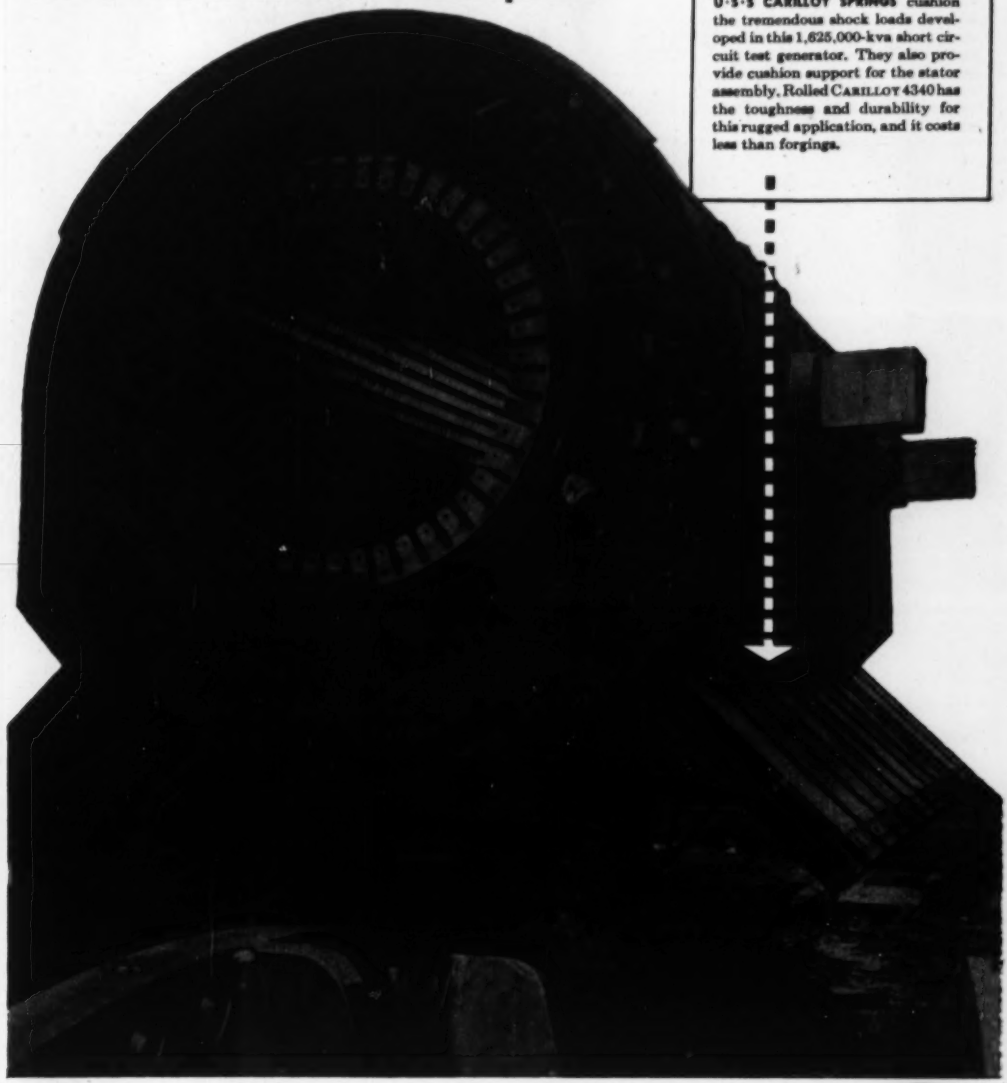
Any time you need a steel to provide high strength and toughness, superior resistance to wear and fatigue, light weight, or any combination of these properties, look for a CARILLOY steel. Experienced U·S·S metallurgists will gladly help you choose the one best suited to your requirements.



THE 200-TON STATOR ASSEMBLY of GE's short-circuit test generators are mounted on CARILLOY plate springs like these. The springs are mounted at a 45° angle to provide both rigid vertical support and cushioning of shock torsion loads. They keep the stator properly aligned with other machine parts at all times.

8 million lb.-ft. torque!

U·S·S CARILLOY SPRINGS cushion the tremendous shock loads developed in this 1,625,000-kva short circuit test generator. They also provide cushion support for the stator assembly. Rolled CARILLOY 4340 has the toughness and durability for this rugged application, and it costs less than forgings.



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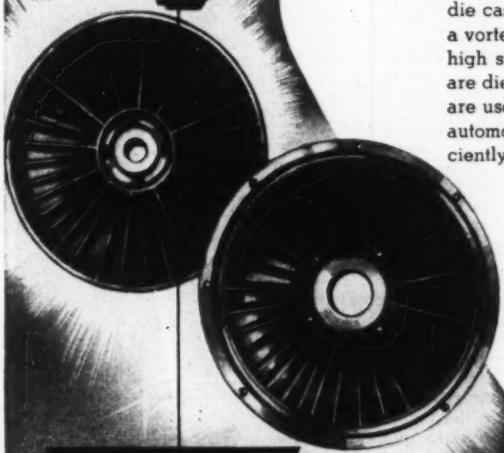

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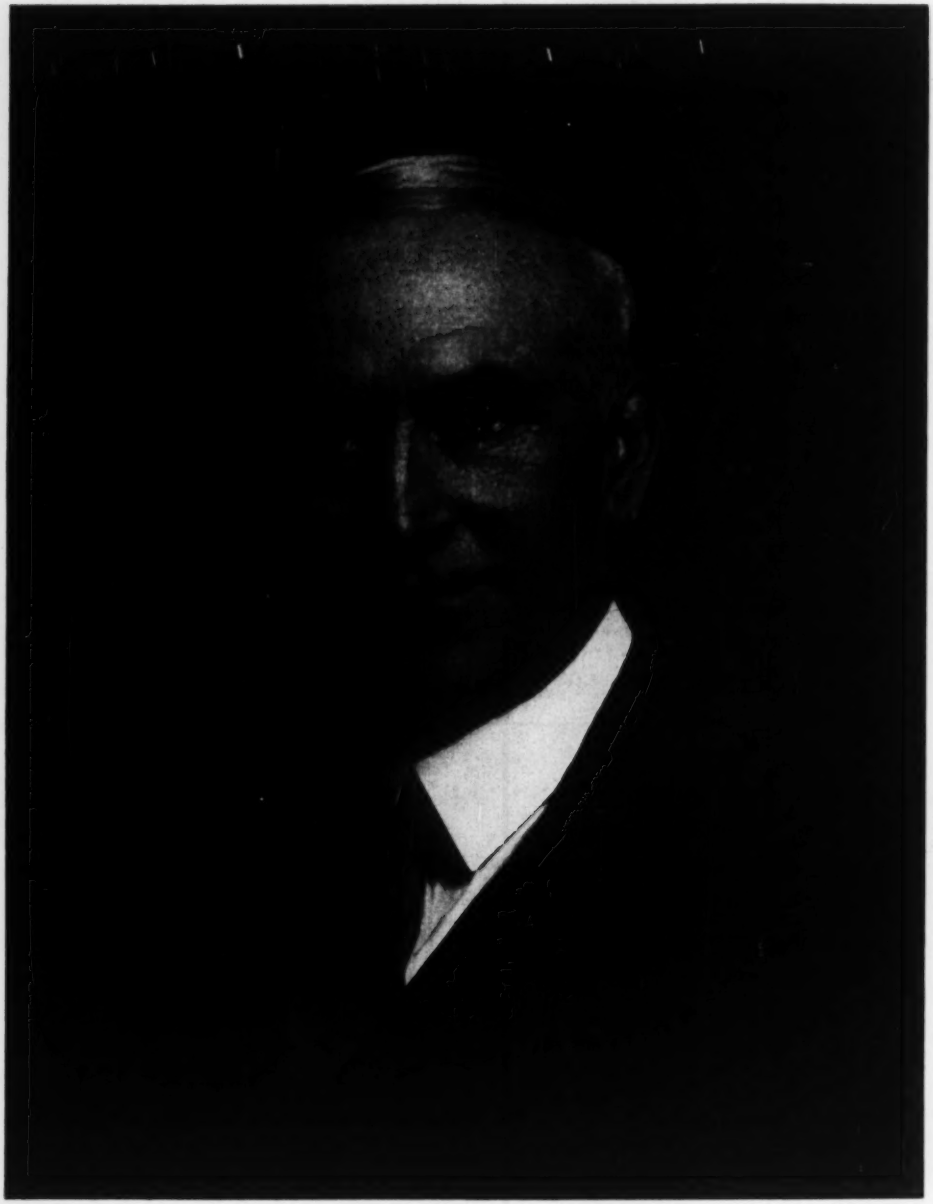

Dexter S. Kimball—1865-1952

Past-President and Honorary Member, ASME

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MECHANICAL ENGINEERING

DECEMBER
1952

GEORGE A. STETSON, *Editor*

Dexter S. Kimball

DEXTER S. KIMBALL, who died on Nov. 1, 1952, will long be remembered for the influence he exerted on undergraduates at Cornell. If the rewards and satisfactions of a teacher are to be found in the successful careers of his students, then, at 87, Dean Kimball had full measure of them. Since the beginning of the present century students who had come as boys and girls fresh from their homes have left Ithaca after four years to take their places in the world, there to put into practice what they had learned and to spread throughout their homes, work places, and communities that optimistic philosophy and zest for life that was so characteristic of their friend and mentor. Few men have so richly deserved and few have so fully enjoyed such warm affection and high esteem of students and colleagues alike.

But Dean Kimball was not Cornell's alone. He belonged also to hundreds of teachers and college administrators and engineers who came under his influence and were inspired by his wisdom, who sought his leadership and counsel, and who remember his alert personality, his keen sense of humor, and the contributions he made to the life of his times.

* * * *

Dean Kimball's ancestors were Maine folk, although he himself was born in New River, New Brunswick, on Oct. 21, 1865. In 1881 his immediate family established a new home on the shores of Puget Sound. Here until 1887 the young Kimball served as apprentice and journeyman in the machine shop of the Puget Mill Company at Port Gamble, Wash., owned by Pope and Talbot, lumbermen. Here he might have lived out his days were it not for the greater opportunities that were calling.

In 1887 the young machinist went to the Union Iron Works in San Francisco, the great machinery and steamship builders of the Pacific Coast. San Francisco was a delight to a youth in his twenties and has been vividly recalled by the octogenarian Kimball in his autobiography, "I Remember." At Union Iron Works Kimball was impressed by the 30-ft boring mill, the gap lathe for machining steamship engine crankshafts, and the variety of tools and measuring instruments he found there. He learned about industrial organization and cost systems, subjects which were to be introduced by him in lectures at Cornell. But he realized also the limitations that lack of engineering education placed on his opportunity for future advancement and decided that he would enter the newly organized Stanford University in spite of his age and the fact that he was doing well as a machinist.

Even for a 28-year-old freshman, life at a new university was an exciting experience. Classwork came easily to Kimball, and summer employment at Union Iron Works aided the financing of his education. But at the end of three years, promise of a position in the engineering department of Union Iron Works threatened to cut short the college career before graduation. Luckily, the wise counsel of Prof. A. W. Smith prevailed, and, by attending the summer session, Kimball was able, in 1896 to secure his first academic degree. In later years, when honorary doctorates were being showered upon him, one of his sons was to address him as "Doctors Kimball!"

The next two years were filled with unexpected events and important decisions for Kimball. Back at Union Iron Works he was assigned to design problems, which included steam engines for mine hoists and a hydraulic press for shaping ship plates. He designed also two sets of double 16 by 30-in. hoisting engines for Anaconda Mining Company and was persuaded to go to Butte, Montana, in 1898, to supervise their erection. Before leaving to take on this assignment, he was married to Clara Evelyn Woolner. Butte, he wrote in later years, was "a forbidding place to bring a bride who was nicely reared," and it was not long before both bride and groom yearned for California. But it was to the East and not the West that the couple went in September, 1898, when John H. Barr, professor of machine design at Cornell, offered the opportunity which led to the long years of teaching and college administration at Ithaca.

When Kimball arrived at Cornell he was thirty-three years old. He had earned his living as a machinist and as a designer. He had been engaged in erection work in the field. He had seen machinery of his own design put to work. His formal engineering education had been acquired under circumstances that convinced him of its value and significance. In the drafting room he had worked with "practical" men who lacked the theory he had acquired at Stanford. He could appreciate what both practice and theory could contribute to design. What better training was there for a teacher who already possessed natural talents and characteristics that inspired confidence, respect, and friendliness in students and colleagues and was eager to get along in the world? But advancement in the teaching profession was slow, and hence, at the end of his first three-year appointment, Kimball was back again in industry, this time as works manager of the Stanley Electric and Manufacturing Company at Pittsfield, Mass.

Changes at Cornell, which came about through the death of Robert H. Thurston, opened up an opportunity for Kimball to return to Ithaca in 1904. There he was to teach until his retirement and to live until his death. He was by then fully dedicated to teaching. His book, "Elements of Machine Design," with John H. Barr as co-author, was published in 1909. The deanship came in 1920. Twice he was called upon to serve as acting president of the university. But he remained a dean, a man, according to his own definition, "who has outlived his usefulness as a professor and is wise enough not to be president!"

With the ripening of the experience he had gained in the shop and the university, he brought forth the lecture series which were first published in book form in 1913 under the title, "Principles of Industrial Organization," a pioneering venture. In the preface he wrote: "Industry is the business of the civilized world and the greater part of our problems, national, state, and home, center around the great industrial questions." Thus he gave to the future leaders of industry who sat under his instruction at Cornell, and to hundreds of others who read his works and listened to his many addresses, the fundamentals of his philosophy of our industrial economy. As he says in his autobiography, "I have lived through a period of the most remarkable scientific and industrial developments in history, during which time I have been in close contact with these technical developments and with the people who are responsible for them." How many of those people owe to Dean Kimball some portion of their success, we can only guess.

Space does not permit even the listing of Dean Kimball's many services to Cornell and the citizens of Ithaca; to engineering education which rewarded him with the Lamme medal; to the engineering profession which elected him to many posts; to the machine-tool industry for whom, it is said, he coined the phrase "The master tools of industry"; to the ASME whose president he was in 1922; and to the nation which found in him a wise counselor and an able administrator in times of need.

The honors showered upon him were many and impressive. Retirement in 1936 from active duty as dean made little difference in the pace of his engagements and a wide variety of interests held his attention until the day of his death. A materials-processing laboratory, recently dedicated on the Cornell campus, bears the name Kimball Hall and will be a constant reminder of his influence and personality.

Mrs. Kimball died in 1949, "the only dark shadow that has fallen on these later years." It was a grievous loss, shared with him by generations of students who forgot the pangs of homesickness and the perplexing problems of adolescence in the warm friendliness of the Kimball household where faith and courage were restored through intimate glimpses of the good life.

* * * *

There exists in memory a portrait of this dynamic dean. He enters with cheery welcome and quick, sure step. He perches his active and slender body on the corner of a desk or table, one foot dangling and swaying to and fro. From his hands hangs a not too elegant hat. He chuckles good naturedly, head cocked on one side. The intense piercing eyes sparkle with interest and good humor. His manner and language are simple, unaffected. Here is a warm, genial, kindly, and friendly person, repeating, like Homer of old, stories that are dear to him.

One such story called for a bit of acting. It was the Dean's impersonation of the serious-minded but dreary college professor at a faculty meeting. Standing behind a table and leaning on his right arm, the Dean would begin a finely spun academic argument with the opening words, "On the one hand." After covering all the points on that side of the case he would shift his weight to the left arm and take a new lease on his theme by saying, "But on the other hand." Thus the objective and analytical mind of the professor would exhaust all of the possibilities of debate on both sides of the question without arriving at a single clear-cut conclusion.

But he was just as quick to see the humor in incidents in which he himself was concerned and to tell stories on himself. When one of his sons was visiting him, the problem of transportation to and from the business section of town at the foot of the hill became acute. It was finally decided that the son should take the Dean's car to town, leave it at a special corner with the key under the mat, and return by some other means. The Dean was to go to town with a neighbor, do his errands, pick up the car where his son had left it, and drive home. All went well until the Dean failed to find the key under the mat. Somewhat annoyed but undaunted, the Dean lifted the hood, by-passed the ignition switch, started the car, and drove home. His son greeted him with no apology for the missing key, and the Dean, proud of his exploit, let it be known, rather smugly, that a professor of mechanical engineering knew enough to start an automobile even if he didn't have an ignition key. "Yes," said his son, "that was very clever of you. But of course this is *not* your car!"

Here, in these and other stories, is wisdom disguised in homespun, and the best of life recaptured and retold by an optimist who had found most things and most people good, and hid from his friends the memories of events that were evil or sad. Here was one who could give "beauty for ashes, the oil of joy for mourning, the garment of praise for the spirit of heaviness." With stories told and farewells spoken, there was a quick movement of the hand to put in place the sparse locks across a balding head, and he was gone, having refreshed and enriched the lives of those he left behind. Strange, it always seemed, that such an interruption of the day's work and such banter should renew a right spirit within one and restore one's faith in men and manners.

Such, briefly sketched, was the life of a man who, at 85, could write: "It is lack of happiness, I believe, which makes old age difficult to bear and old men sometimes intolerable. . . . I have never lacked for friends or work . . . I have lived a good life; I have had more honors bestowed upon me than I perhaps deserve, and people have been good to me and my wife. . . . And I am not anxious to depart."

Effects of SOLID INCLUSIONS *in* SLEEVE-BEARING OIL SUPPLY

By H. GRADY RYLANDER

ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING, THE UNIVERSITY OF TEXAS, AUSTIN, TEXAS. JUNIOR ASME

SLEEVE bearings operated under normal conditions are always subjected to some foreign solid particles in the oil supply. Internal-combustion engines produce solids in the combustion process; other particles are produced by wear; and others enter as dirt, rust, and scale from the air or piping. A thorough understanding of the operating characteristics of sleeve bearings when subjected to certain particles in the oil leads to an improved design of bearings, shafts, oil, and oil filters.

The problem of filtering out small particles below 10 microns in size is extremely difficult, and in the majority of applications only a small percentage of the oil-pump discharge is filtered. Even full-flow filters have by-pass arrangements to insure an oil supply to the bearings in the event the filter becomes clogged. Commercial automotive cartridge filters will not effectively remove particles below 8 microns and some will pass particles as large as 25 microns.

In most bearing-test programs, the bearings are carefully tested under conditions such that extremely small amounts of dirt and impurities are passed into the bearing by the oil supply. This practice leads to design loads that are too high. It is now recognized by those who develop their designs under actual service conditions that such factors as fatigue strength, temperature limitations, friction, wear resistance, elasticity, antiseize properties, and embedability are also important as well as load-carrying capacity. No one bearing material has been found that will solve all of these requirements.

Several of the bearing-design conditions mentioned may be altered seriously by using oil contaminated with solid particles. Bearing operating temperatures may be changed, wear increased, friction varied, embedability destroyed, and antiseize properties changed by adding solid particles to the oil.

S. A. McKee conducted one of the first tests of bearings with solid particles in the oil. His paper[1] was published in 1927. Subsequently little was published on the subject until 1951, when A. E. Roach[2] presented a paper discussing the performance of oil-film bearings. Many tests have been conducted in actual machines and engines, where the exact nature of the particles was unknown or the particles were of several materials and many sizes. In this paper specific information is given on the bearing operating characteristics when using oils containing varying particle sizes and concentrations of graphite, molybdenum sulphide, red rouge, and corundum particles.

TEST APPARATUS

In most bearing test machines, torque to four identical test bearings is measured and divided by 4 to get the average torque for a single bearing. This type of machine does not give an individual concept of the operating characteristics of any single bearing; also, four bearings are needed for each test. The test machine shown in Figs. 1, 2, and 3 was designed to measure accurately the torque produced by a single bearing, thereby increasing the accuracy of the test and reducing the number of test bearings required for a program of the sort where one bearing was useful for only a few hours of testing.

Steel-backed babbitt bearing inserts were used as test bearings and support bearings in the test machine. These inserts were 2.168 in. ID × 1 in. long with a lead-base-babbitt thickness of 0.020 in. A bearing housing and seal assembly is shown in Fig. 4. It was found necessary to provide one axial groove into the $^1/_4$-in. oilhole on the unloaded side of the bearing to maintain sufficient oil flow under all test conditions without exceeding 100 psi oil-inlet pressure.

The test shaft was made of solid SAE 4142 steel hardened to 350 Bhn and ground to size with a surface roughness of approximately 16 microinches rms. Several test positions were made on one shaft by using different lengths of flexible drive shafts, thereby placing unused sections of the shaft under the test bearing.

Loading was applied hydraulically through a linkage which provided a 2 to 1 increase in the load and was self-centering on the test shaft. Hydraulic pressure was the measure of radial load on the calibrated system. Loads over 8000 lb could be applied; however, only 5000 lb was used in the first series of tests due to limits on the bearing capacity.

The drive motor was direct-drive with variable speed from 3000 rpm to 3500 rpm. Electronic speed controls gave accurate and easy control of the Louis Allis unit. Torque was constant with a maximum of a little over 5 hp at 3500 rpm. A piece of $^3/_8$-in. shaft was used between the motor and test shaft as a flexible link as well as protection to the motor in case of bearing seizure.

The oil system connected to the test bearing consisted of a tank, oil heater, oil cooler, pump, control valves, rotameter, and oil pressure gage. A special oil reservoir was designed with a steep-sided conical bottom to keep the solid particles from settling out of the oil. The oil-pump intake was connected to the bottom of this cone on the oil tank. By using an oil pump with a capacity of approximately 5 gpm, the oil was kept in circulation as only $^3/_4$ lb per min was delivered to the test bearing. Settled-out particles from the bottom of the cone were deposited on top of the oil in the reservoir by the circulating pump.

Very little trouble was experienced in keeping the solid particles suspended in the oil long enough to transport them to the bearings. The use of SAE 30 oil, rapid circulation, and a conical tank allowed very few of the smaller-size particles to settle. Only with the 22-micron corundum did the particles settle out appreciably. The worst place in the system was the upflow over the rotor in the rotameter. Visual inspection would show when particles were settling on top of the rotor.

[1] "Effect of Abrasive in Lubricant," by S. A. McKee, *S.A.E. Journal*, vol. 20, 1927, pp. 3–6.

[2] "Performance of Oil-Film Bearings With Abrasive-Containing Lubricant," by A. E. Roach, Trans. ASME, vol. 73, 1951, pp. 677–686.

Contributed by the Machine Design Division and presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15–19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

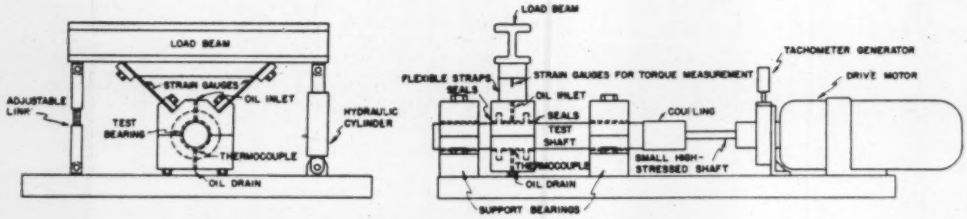

FIG. 1 END AND SIDE ELEVATIONS OF BEARING TEST MACHINE

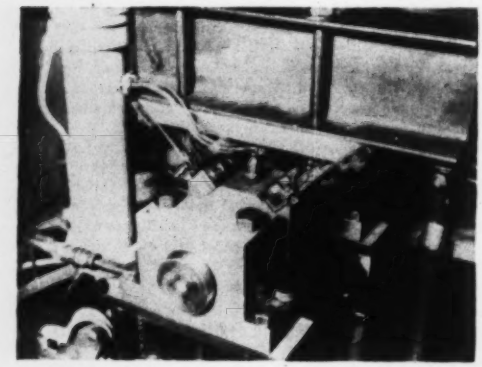

FIG. 2 TEST BEARING MOUNT FOR TORQUE MEASUREMENT

TEST PROCEDURE

For each particle type a new bearing was installed in the test housing and an unused portion of the test shaft was matched with the new bearing. A weighed portion of solid particles was mixed with a given amount of oil in the test reservoir before starting the main test motor. Next, oil circulation was started along with the oil heater in order to bring the oil and test bearing up to temperatures near 140 F. Shaft rotation was started when the oil-inlet temperature was within 4 deg of 140 F. Then the test-shaft speed was set, test load applied, and the oil flow regulated to approximately $^3/_4$ lb per min.

Data were recorded for varying speeds and loads to span values of ZN/P from about 5 to 100. In some cases the low values could not be obtained because of insufficient power in the test drive, but these points were on the steep portion of the curve where marginal lubrication occurs. About 4 hr were required to make each test run.

The experimental test program was arranged to obtain first a basis of comparison by using clean oil, then to proceed to soft small particles and increase the particle size, concentration, and hardness until some definite influence upon the operating characteristics of the bearing was obtained. In order to carry out this program, the following particles and concentrations were tested in the order shown:

(*a*) Graphite $2^1/_2$ microns (concentration of 0.47 gram/gal to 1.87 grams/gal).
(*b*) Graphite 10 microns (concentration of 0.47 gram/gal).
(*c*) Graphite 30 microns (concentration of 0.94 gram/gal).
(*d*) Molybdenum sulphide 39 microns (concentration 0.47 gram/gal to 1.87 grams/gal).
(*e*) Red rouge 1 micron (concentration 0.47 gram/gal to 17.0 grams/gal).
(*f*) Corundum 8 microns (concentration of 0.47 gram/gal).
(*g*) Corundum 11 microns (concentration of 0.47 gram/gal).
(*h*) Corundum 22 microns (concentration of 0.47 gram/gal).

TEST RESULTS

A calibration run with clean oil is plotted as fc/d versus ZN/P in Fig. 5. In this same figure are plotted two important equations for the coefficient of friction of sleeve bearings as a comparison with the test values. Reynolds' theoretical solution of the basic theory of hydrodynamic lubrication is the low limit to the coefficient of friction and is not to be expected in actual bearings for all operating conditions.

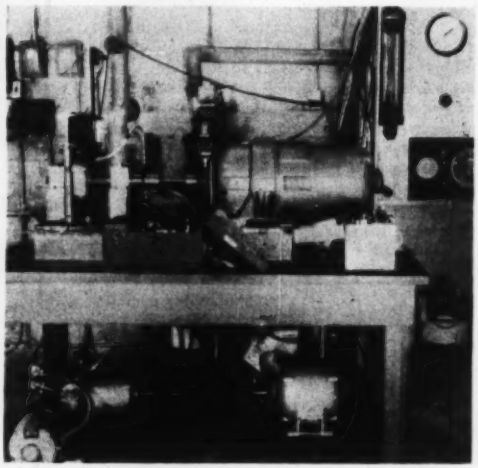

FIG. 3 GENERAL VIEW OF BEARING TEST MACHINE AND ACCESSORIES

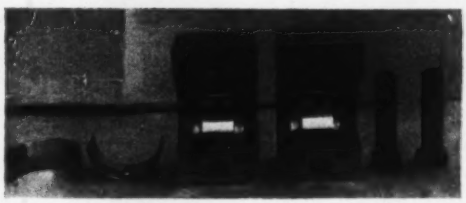

FIG. 4 BEARING HOUSING AND SEAL ASSEMBLY

The curve marked "McKee"[3] in Fig. 5 is the solution of his equation corresponding to an L/d ratio of 0.5. This equation was not recommended to be used for values of ZN/P less than 100, but it does serve as a check against the upper end of the friction curves.

Particles of graphite and molybdenum sulphide in concentrations below 1 gram per gal did not change the friction curve from that of clean oil. As shown in Fig. 6, values of friction for oil containing 0.94 gram per gal of $2^1/_2$-micron graphite would plot approximately the same curve as clean oil.

As the particle concentration of graphite and molybdenum sulphide was increased over 1 gram per gal, there was a noticeable but small increase in friction for the larger values of $ZN/P = 60$ to 100. A $2^1/_2$-micron graphite at a concentration of 1.87 grams per gal produced an average value of $(fc/d) \times 10^6$ of 9.8 as compared to that of clean oil $(fc/d) \times 10^6$ of 8.1 for the same ZN/P of 90. At ZN/P values between 5 and 30 there were no noticeable changes in friction or the seizure point which occurs slightly below a ZN/P value of 5 for soft particles.

A slight decrease in the coefficient of friction occurred for small concentrations of rouge. This was the only type particle tested that produced less friction than clean oil. It is possible that the small concentration of rouge merely improved the shaft and bearing surface by a polishing action, thereby decreasing the friction rather than increasing it. In concentrations of 1.87 grams per gal and 17 grams per gal the coefficient of friction was equal to or above that of clean oil.

Corundum in oil from sizes of 8 microns to 22 microns increased the coefficient of friction, produced large wear in the larger sizes, and gave erratic results owing to rapid wear and changes in the surface. Only the 8-micron corundum ran under load with a film thickness approaching the particle size. When the minimum film thickness exceeded the particle size, there was a definite trend toward lower frictions.

Oil with 11-micron corundum as shown in Fig. 7 produced considerably higher friction than clean oil. These high friction values were associated with a clearance change from 0.0026 to 0.0036 in. in 6 hr of operation.

Three hours of operation with 22-micron corundum had worn the shaft so severely that seal rubs began to develop. The increase in the coefficient of friction to 5 times that of clean oil was accompanied by an increase in clearance from 0.0026 to 0.0087 in. in 3 hr of operation.

Fig. 8 shows the increase in friction with the increase in particle size for corundum concentrations of 0.47 gram per gal. A large shift in the wear rate takes place at particle sizes of approximately 350 microinches. Similar rapid increases in friction also take place at about the same point indicating a definite association between the friction and wear rate.

Fig. 9 compares the bearing temperatures using clean oil with oil containing 0.47 gram per gal of 11-micron corundum. Actually, a direct comparison between bearing temperatures of the two tests cannot be made as the operating clearances were different; however, it does prove that the bearing temperature rise is relatively small compared to the large increase in fc/d values.

This fact may be explained partially by increased heat transfer and the increasing clearance which tends to decrease bearing-friction losses. Even if clearance is not provided by the initial assembly, wear will produce additional clearance rapidly.

Graphite particle size had no effect upon the bearing friction or the oil pressure required to force $^3/_4$ lb of oil per min through the bearing, but graphite concentration did change these charac-

[3] "Friction of Journal Bearings as Influenced by Clearance and Length," by S. A. McKee and T. R. McKee, Trans. ASME, vol. 51, 1929, pp. 161–171.

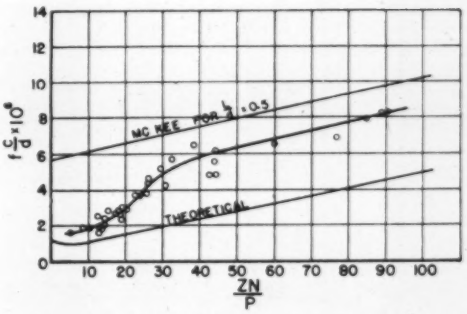

FIG. 5 FRICTION CURVES FOR CLEAN OIL

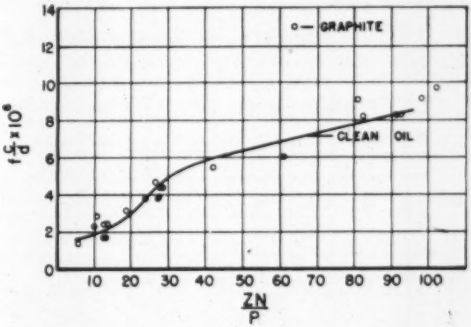

FIG. 6 FRICTION CURVE FOR $2^1/_2$-MICRON GRAPHITE CONCENTRATION OF 0.94 GRAM PER GAL

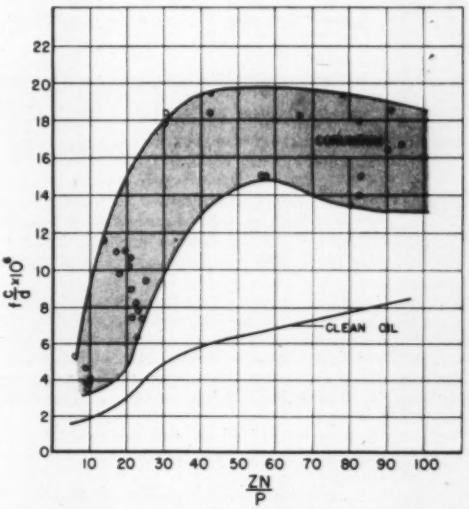

FIG. 7 FRICTION CURVE FOR 11-MICRON CORUNDUM CONCENTRATION OF 0.47 GRAM PER GAL

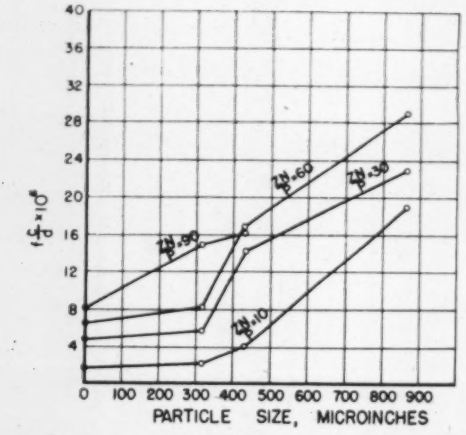

FIG. 8 FRICTION INCREASE CAUSED BY INCREASING PARTICLE SIZE

(Corundum concentration of 0.47 gram per gal.)

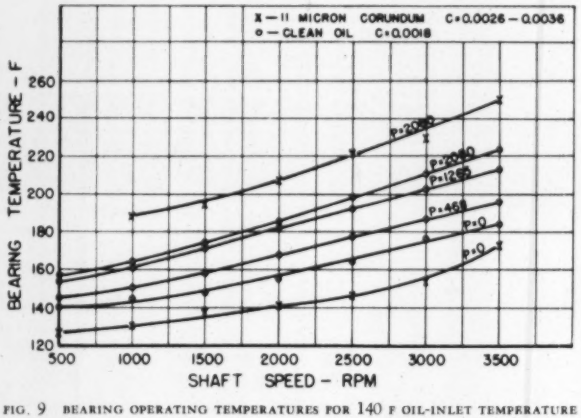

FIG. 9 BEARING OPERATING TEMPERATURES FOR 140 F OIL-INLET TEMPERATURE AND OIL FLOW OF $\frac{3}{4}$ LB PER MIN

teristics. As the graphite concentration increased, the oil pressure required to force the same amount of oil through the bearing increased. This increase was not regular and depended on the time allowed for graphite to collect in the oil grooves.

No wear could be detected on the bearings and shafts used with graphite, molybdenum sulphide, and rouge. Even though the shaft was plainly marked with rouge, the original grinding marks could still be distinguished on the shaft surface. Since these results were obtained with only 16 hr of operation on rouge, it is likely that continued operation would cause measurable wear.

The oil pressure required to maintain a constant flow did decrease with rouge, which indicated that internal changes were taking place.

Color and transparency measurements were not made on the oil except by visual inspection. Concentrations of finely divided black particles of graphite and molybdenum sulphide over 1 gram per gal produced very noticeable oil discoloration. Red-rouge concentrations over 1 gram per gal produce red-tinted oil.

Incidentally, these small rouge particles cling to surfaces and are extremely hard to clean out of the system. Corundum particles in small concentrations are hard to see in oil unless a bright light is shown through the oil; then they are bright enough to reflect light.

CONCLUSIONS

The results of this investigation as presented in this paper are dependent upon the accuracy of instrumentation and the care and procedure involved in conducting the test program. In order to improve the test accuracy, a large number of test points were recorded from which the following conclusions were obtained, based upon average operating conditions:

1 Soft particles of graphite and molybdenum sulphide in the oil supply to lead-base-babbitt sleeve bearings will produce no improvement in the bearing operation.

2 Graphite particle size has no effect upon the bearings' operating characteristics when used in small concentrations as in this program.

3 Graphite particle concentration will produce a change in the bearing oil-flow characteristics. Increased concentration will increase the oil pressure required to maintain the same oil flow.

4 The coefficient of friction may be increased by increasing particle concentration.

5 Only the tests with small amounts of rouge caused friction values lower than clean oil.

6 Particles of hard substances must be larger than the minimum oil-film thickness to cause appreciable increases in wear or friction.

7 Wear may take place without a large increase in the bearing temperature.

8 Shaft wear may be much more rapid than bearing wear owing to the babbitt embedding the large sharp particles.

9 Oil may be discolored by small concentrations of finely divided particles, but a discolored oil does not indicate the friction to be expected in a bearing. Very small amounts of hard particles will cause rapid wear even though the oil looks clean.

10 Filtration that removes any-size particle will be helpful, but the removal of all particles larger than the minimum oil-film thickness is required to stop wear and increased friction. This means that for most of our high loaded bearing applications, filtration must remove particles considerably smaller than 25 microns.

NOMENCLATURE

The following nomenclature is used in the paper:

c = diametral clearance between journal and bearing, in.
d = bearing diameter, in.
f = coefficient of friction
N = shaft speed, rpm
P = bearing pressure, psi of projected area
Z = oil viscosity, centipoise

ACKNOWLEDGMENT

The author wishes to express his thanks to Messrs. Venton L. Doughtie, H. W. Luetkemeyer, and B. P. Robertson for their assistance and suggestions in this experimental program.

Bringing the Engineering Viewpoint to Bear on PUBLIC AFFAIRS

A Realistic Approach

By GLENN B. WARREN

GENERAL MANAGER, TURBINE DIVISION, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y. FELLOW ASME

I WANT to speak tonight on a subject about which I think there is some misunderstanding, namely, the participation of engineers in public affairs. I want to try to analyze the situation and present what I hope may be some constructive suggestions.

As I think we all know, the world is in a critical situation today—probably the most critical in its history—critical not only as to peace or war but as to whether or not we can keep our hard-won freedom. With the speed at which we move today, it could be fatal if proper advice is not given to and followed by those who have in their hands the power of shaping events.

There are those who blame the progress of science and engineering for much of this difficulty, and say that the engineer and scientist should now get us out. Many older engineers take a look back at their own careers and a look at the world and become conscience-stricken at how neglectful they have been of important matters other than engineering. They then rush out to tell the younger men how they, the younger men, must participate in the affairs of their communities, their state, and of our nation in politics, administration, advice, and guidance.

To illustrate, Governor Kohler, in an excellent address here last year, said, "With few exceptions, both the engineer and the physical scientist hold aloof from all but the technical life of our times, and are wholly detached from its politics." And again, W. C. Mullendore, president of the Southern California Edison Company, said last December at the ASME Roy V. Wright lecture:[1]

"Engineers have a special responsibility because their training and experience teach them the importance of fixed principles and immutable laws, and the dangers flowing from ignoring and disobeying them . . . . . .

"I am concerned least it be said of us by our children that when their heritage was being destroyed, their fathers, notwithstanding their education and opportunity to know the facts, were so busy with their electrons and formulas, with their great engineering projects and perfection of television and gadgets, that they had no time to help in the preservation of the fundamental liberties without which the whole of that heritage will be lost."

I do not disagree with these broad premises. I feel that the engineer has both a right and an obligation to participate. He, with the scientist, has made the conquest of nature and of poverty a possibility for the first time in mankind's history; but his progress in this endeavor is being continually thwarted by recurring cycles of unemployment or by the squandering of our substance on wasteful international conflicts; that is he is being thwarted by our inability to so conduct our economic and political affairs as to permit these possibilities of the conquest of nature and of poverty to become the realities for the good of man that they otherwise might have become.

This is understandable. Science and engineering have leaped forward since the introduction of the experimental method of a few centuries ago; but unfortunately, this method cannot be applied so readily to the economic, industrial, political, social, and other human-relations problems. We cannot so easily put people in test tubes. We accordingly have a world which is almost on the verge of committing suicide because it has new tools and new techniques which it does not yet know how to use or control.

In connection with these broad problems, the engineer cannot and I do not believe has abdicated or side-stepped the obligations imposed by his citizenship, although he may not be as vocal about it as others.

That, however, is not what those who plead with the engineers to take more of an active part in public affairs mean. They seem to want to expect a greater personal participation in the affairs of government, federal, state, and local by all engineers than has now been attained.

But now let us look at the practical results of these pleas that engineers participate more fully in affairs other than engineering.

In the first place, mature engineers are taking an increasing lead in the general management of business enterprises. This is particularly marked in the technical industries, and should have beneficial results as the years go on. Further, it has been my observation that the engineer takes as a solemn duty and trust his normal duties of citizenship, that is, voting and being interested and informed on public issues; but despite the need and constant pleading of many of the older and wiser engineers, the participation of engineers in public affairs is very little in comparison with that of lawyers, businessmen, and professional politicians—yes, and perhaps much less than that of college professors.

For example, in my adopted home city of Schenectady, we have perhaps the largest percentage of engineers to the population of any city in the country—ten times the national average; and we have an excellent engineer as city manager—and yet we have a negligible engineering participation in local government, and a government which could be greatly improved by such participation. An examination of other communities and of the participation of engineers in state and federal government will show the same situation—little participation on the part of engineers.

Let us examine the reasons for this situation. I think the prime and foremost reason is that the engineer has been too busy, particularly for the past twelve years, to do anything

[1] "The Retreat From Freedom," by W. C. Mullendore, MECHANICAL ENGINEERING, vol. 74, no. 2, February 1952, pp. 135–139.

An address presented at the Engineers' Day Dinner, May 2, 1952, University of Wisconsin, Madison, Wis., at which Mr. Warren, a graduate of the Class of 1919, received a citation for distinguished engineering service.

else. We have a well-known shortage of engineers—a deficiency which many well-informed men feel is such that two to three times the present graduation rates could be profitably absorbed. One has only to read the advertisements of "Engineers Wanted" in the metropolitan and trade papers, or to check on the intensity of the recruiting on your own campus to realize that this is so.

Another factor which many of you may not be close enough to industry to realize is that we have been making from thirty to perhaps fifty years' normal progress in many lines of technical activity during the past twelve to fifteen years. Our rate of technical development is tremendous. Our rate of technical progress today is two to five times what it was. One has only to consider the progress in such things as jet propulsion, aircraft design, electronics and radar, atomic energy and atomic power, the power industry, as well as the development of new military materiel and of new manufacturing and chemical processes, to realize that this is true. Much of this is due to war and defense needs; some is due to the lack of progress in the thirties.

The result is that the engineering content and the intensity of the engineering activity have increased to an extreme degree. The technical responsibilities of the individual engineer have increased many times. Most engineers are extremely conscientious and take their responsibilities seriously. I know many of them feel that, strive as best they can, still their very best efforts fall far short of what the job asks. Basically, this job that they have been doing is a good job; it has had as its end and objective the raising of the standard of living and the insuring of our security.

Add to this the time and energy required of young and middle-aged engineers in the efforts which they must make to continue with their postgraduate on-the-job training, and to keep abreast of this rapid progress in their field, or in related fields of activity, and you have an unprecedented load on the individual engineer today. Furthermore, if you then add the complexities and increased load introduced by government and security regulations, the pressures brought to bear because of the necessities for cost reductions required to meet the increasing labor and materials costs, and the increasing corporation taxes, you have a situation in which few capable and conscientious engineers have the time and energy left for these other obligations, no matter how pressing.

Another reason has to do, I believe, with the fact that the engineer instinctively realizes that the public affairs of today have become big and baffling problems—not to be solved offhand by the part-time application of a mind, no matter how acute. The governments of most of our communities, states, and above all, the nation, whether we like it or not, have become big business. For example, the General Electric Company did about two and one-half billion dollars of business last year. The quality and size of its full-time engineering and management organization is well known, and yet the entire General Electric Company with its more than one hundred plants is but one thirty fifth the magnitude, based upon the budget, of the federal government establishment. The needs of our public affairs that can be satisfied by the engineering viewpoint cannot be met with the part-time participation by men in government service and in public affairs who have this engineering and administrative training and background.

If this is so, then let us see what we can do to satisfy these needs.

First, we can insist as citizens that the participation of government in business, particularly technical business, be strictly limited to those functions which government can and should be able to perform better than private groups; thus the need will be less.

Second, we, in this country, can undertake to educate more boys with proper qualifications for the engineering profession. I am told there is a great reservoir of young men with potential engineering talent in the high schools, but who, because of improper guidance or adverse economic circumstances, will not now take engineering. This should be remedied by whatever steps are necessary.

Third, as citizens, we can insist that government salaries for such talent be comparable to that of private business; that the jobs carry equal dignity and security so as to attract and hold capable men, and to hold them for their entire career, against the competition of private business for their services.

Fourth, with the general adoption by industry of sixty-five-year retirement plans, and there are sound reasons in industry for this, there will be created a group of experienced engineers and administrators who should be encouraged to go into public or government service for periods of from three to five years. This is, of course, already being done to a considerable degree, but much more can be accomplished in the future. These men have the training and the background and can bring a wealth of fine experience and judgment to bear on these problems.

Then I am wondering if there isn't a fifth and best approach of all, a supplement to these others. Can't we train and develop a group of professional public-affairs administrators, at least to a much greater extent than we are now doing?

Prior to the American and French Revolutions, many of our government administrators were military men. Military affairs were the things with which government largely had to do. Then through the nineteenth century, the affairs of state were to a great extent those having to do with the relations between people. This was the lawyers' natural professional domain, and hence the legal profession became, together with the ranks of the professional politicians, the sources from which we drew our public administrators.

Today, government includes many big undertakings of an economic, industrial, construction, or procurement nature. Now we need many trained public administrators and technical or semitechnical managers in addition to men trained in the law, political, and diplomatic affairs.

Can't we then analyze the characteristics and the viewpoints of an experienced engineer that make people of judgment think that he would be of help in public affairs? Can't we find out what it is that he knows that is considered of value in public affairs and train young men in these things?

Surely it is not his ability to work a slide rule, to figure out a trigonometric function, to set up an integral, to run a lathe, or to test a heat engine, or even to invent a new device or chemical process. It seems to me, rather, we believe the engineer might be valuable because of his basic knowledge of such things as the physical, chemical, and thermodynamic sciences, his knowledge of industrial, engineering and power economics, his understanding of structures in the broad sense, but most probably his honesty of approach developed because he has learned that nature can't be cheated, nature can't be made to produce something for nothing. In addition, perhaps it is his knowledge, in the case of the more mature engineers with management experience, of the handling of people in large technical affairs, a faculty usually acquired only after years of personal experience in management. Also, a good engineer, before deciding on a course of action, gets all the facts he can, examines possible alternative courses and the results that would accrue, and tries to select the optimum.

It seems to me we need here, to a great extent, the same characteristics that are needed by industry for its general and

(*Continued on page 982*)

GASKETS *for* HIGH-PRESSURE VESSELS

By A. R. FREEMAN

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IT HAS been estimated that, if mating surfaces are held together to make a pressure-tight seal, tolerances on the order of molecular magnitudes should be maintained on them.[1] However, such micro-surfaces are difficult to produce and are highly impractical from a commercial standpoint. Thus, gaskets are employed to obviate their necessity.

As originally developed, a third member of a joint (gasket) was introduced between the two mating surfaces. The gasket, being made of a relatively soft material, as compared to the mating surfaces, would deform and thus effect a seal by filling all of the surface irregularities of the mating pieces. For low pressures, gaskets made of rubber, leather, cork, and the like, may be placed in a joint to effect a seal. For higher pressures, however, and under severe conditions, gaskets made of soft substances tend to extrude and make maintenance of joints difficult for general use.

GASKET METHODS FOR SEALING PRESSURE VESSELS

There are several different ways in which gaskets may be used to seal pressure vessels. Fig. 1 illustrates the simplest form of the flat gasket seal (the small, V-shaped projection of the gasket into the vessel body is used merely to hold the gasket in place, but is not necessary to its function).

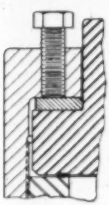


FIG. 1 FLAT GASKET SEAL

The components of the seal are not complex, and the seal is, in general, satisfactory in small openings for pressures to about 20,000 psi or even 50,000 psi. As may be seen from the illustration, the gasket fits into a recess which holds it in place and prevents its radial extrusion under high pressures. The sealing force, which must be applied to the joint, must be great enough to cause elastic or plastic deformation of the gasket; and it is, therefore, reasonable that the narrower the gasket, the better its sealing characteristics, since less force is required to make the seal. This holds true only to a point where the gasket is so narrow that internal pressure causes it to become unstable. This point of instability may be calculated, using the conventional formulas for thin rings subjected to uniform internal pressures. The thickness of flat gaskets may be varied between the points where the gasket is so thin that it will not flow sufficiently under the applied force, to the point where it is so thick that it tends to flex or even buckle under the applied force.

Bridgman Closure. Another type of high-pressure seal utilizing a flat gasket is the original version of the Bridgman closure.[2] This type of closure is illustrated in Fig. 2. In this case a thick gasket is confined by the vessel head, the retaining nut (or a retaining ring), and the inside wall of the vessel. The flat gasket, as used in this closure, being confined, is forced against the periphery of the head and the vessel wall, thus sealing the vessel. The gasket for this type of closure may be made of such varied materials as rubber, lead, copper, soft steel, etc. This joint functions in an entirely different manner from that previously described and utilizes the unsupported-area principle, as proposed by Dr. Bridgman. By this, we mean that the internal pressure acts on an area which exerts force on the gasket, but which is greater than the sealing area of the gasket. Therefore, the force tending to secure the seal will always be greater by a fixed ratio than the internal pressure in the vessel. The only external force which need be applied to the closure to effect a seal is that required for initial flow of the gasket material; subsequent pressure in the vessel will cause the gasket to deform and maintain this seal. Closures of this type are known as self-sealing closures because they tend to tighten with increasing internal pressure, as differentiated from the flat-type gasket closure previously described where a greater applied force is necessary to maintain a gasket seal as internal pressure is increased.

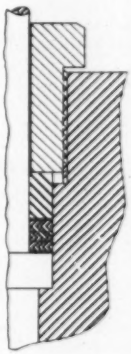


FIG. 2 ORIGINAL BRIDGMAN-TYPE CLOSURE

This version of the Bridgman closure, under very high internal pressures, may give rise to conditions where the force of the gasket against the stem or unsupported section of the head and the vessel wall is so great that it may pinch off the stem or cause failure in the vessel wall either by splitting it or deforming it to a point where the gasket will extrude from the vessel. A seal of this type also can be utilized for pistons in high-pressure pumps and intensifiers, as well as in static applications.

Modified Bridgman Closure. Many modifications of the original Bridgman closure have been developed for industrial applications; i.e., the closures of Bredtschneider, Baker, Nevius, and others. A typical closure of the modified Bridgman type is shown in Fig. 3.

Essentially, these closures are similar to the original Bridgman closure except the gasket surface is relatively small as compared to the surface of the underside of the head. The gasket may be of various shapes, of which one of the commonest is shown in Fig. 3.

The Bridgman closure is considered by some authorities to be the strongest type of closure commonly used on pressure vessels. To Bridgman, in his work at very extreme pressures, this great strength was necessary, but it is not required for the usual pressures encountered in the chemical industry. In all of its forms,

[1] "The Design of High-Pressure Plant and the Properties of Fluids at High Pressure," by D. M. Newitt, Clarendon Press, Oxford, England, 1940.

Contributed by the Industrial Instruments and Regulators Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and presented at the Seventh National Instrument Conference, Cleveland, Ohio, September 9-10, 1952.

[2] "The Physics of High Pressure," by P.W. Bridgman, G. Bell & Sons, Ltd., London, England, 1949.

the Bridgman-type closure requires extremely fine workmanship and expert handling of the component parts to effect a satisfactory seal.

O-Ring Gasket. Another type of gasket, which was developed directly from the flat gasket, employing the unsupported-area principle, is the O-ring, Fig. 4.

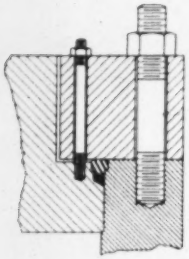


FIG. 3 MODIFIED BRIDGMAN CLOSURE

FIG. 5 ACTION OF O-RING GASKET UNDER PRESSURE

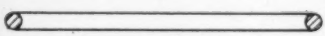


FIG. 4 O-RING GASKET

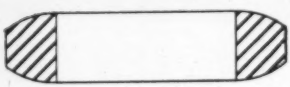


FIG. 6 LENS-RING GASKET HAVING ROUND SIDES

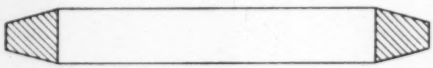


FIG. 7 LENS-RING GASKET HAVING STRAIGHT SIDES

This gasket is similar to the flat gasket, but has a circular cross section. Even for high-pressure service, O-ring gaskets are made of natural or synthetic rubber or plastic materials. O-rings have found wide acceptance as high-pressure valve packings and piston rings, as well as in vacuum and low-positive-pressure applications. They are used to some extent as gaskets for high-pressure vessels; and perform satisfactorily, provided they are well confined in grooved seats, and temperatures of use are kept moderate. When pressure is applied to an O-ring seal, the O-ring is forced against the wall of the seat, as in Fig. 5.

There is no leakage between the O-ring and the wall, since at zero pressure the resilience of the material furnishes the sealing force, and under a finite pressure the gasket is deformed and the seal is maintained.

Because of the softness of the material and the shape of the gasket, less force is needed to cause initial flow than is required with flat metallic gaskets, but for these same reasons, they will tend to extrude more under lower pressures than will flat metallic gaskets. The familiar soft-iron toroidal gaskets used in many moderate-pressure installations are essentially metallic O-rings, and function satisfactorily in service too severe for nonmetallic O-rings. A further modification of the O-ring, originally of British origin, but now in use to some extent in this country is the gas-filled metallic O-ring. These are made of seamless metal tubing and are filled with gas at about 600 psi pressure. After filling they are welded-closed permanently. These gaskets are reported to function very satisfactorily at pressures far above those at which rubber O-rings are usable; the gas under pressure providing a resilience similar to that provided by rubber.

Lens-Ring Gasket. Another type of gasket, employing the unsupported-area principle, quite widely used at high pressures, is the lens-ring gasket. This gasket is better adapted to small rather than to large openings, although, at times, it has been used successfully in sizes up to 2 ft in diameter or more. These gaskets were developed in Germany directly from the flat compression gasket at about the time high-pressure processes came into industrial use.

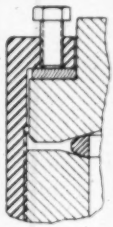
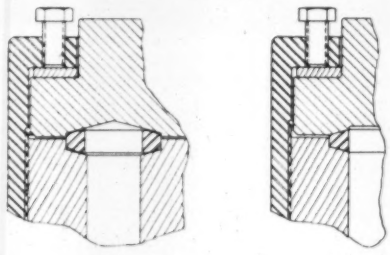


FIG. 8 METHOD OF SEATING LENS-RING GASKET

There are two general forms of this gasket, one having round sides and the other having straight sides, Figs. 6 and 7, respectively. A seal is formed between the sides of the gasket and the seat of each mating member. The principle of the gasket is that, after an initial seal has been made, internal pressure pushes against its thick inside periphery, forcing a tighter seal to be made on the sealing surface located along the thinner portion of the gasket. Thus the unsupported-area principle comes into effect.



(*a*) (*b*)

FIG. 9 STANDARD BRITISH PRACTICE FOR LENS-RINGS
(*a*, Spherical lens-ring application. *b*, Flat lens-ring application.)

Seating Lens—Ring Gaskets. There are several methods for seating lens-ring gaskets. The standard German practice is to use spherical lens rings and seat them as shown in Fig. 8, so that theoretically a line seal is obtained. Sometimes straight-sided lens rings are seated in this manner also. The outer periphery of the gasket is unconfined, so that it can expand freely as the sealing force increases. The standard British practice, and one which has been largely adopted in this country, is to use either flat or spherical lens rings and seat them in the manner as shown in Figs. 9 (*a*) and 9 (*b*) so that they will be confined completely.

Such a seating arrangement clearly does not take full advantage of the self-sealing qualities inherent in this type of gasket. When assembling a closure, utilizing a lens ring in this manner, sufficient force must be applied in order that the gasket will deform inwardly. As internal pressure is applied, the gasket expands, forcing a tighter seal to be made. As the gasket is confined completely, it can only expand to the limit of the recess boundaries, and thus its self-sealing qualities are limited. Though completely confining lens-ring gaskets makes their seating more difficult and limits their self-sealing qualities it, nevertheless, increases their safety as they cannot "shoot" from a vessel, should they fail while in service.

Proportioning Lens-Ring Gaskets. Properly proportioned lens-ring gaskets function quite satisfactorily; but this proportioning is rather empirical; so many effects must be taken into account that more rigorous methods of design seem to lead only to inconsistencies and compromises. Whenever lens rings are used, there is a vertical component of the sealing force which tends to wedge the head from the body of the vessel. The magnitude of this wedging force is governed by the angle of the sides of the gasket (or slope of the tangent at the point of sealing in the case of a spherical gasket). Mathematically, the wedging force may be calculated roughly, assuming the gasket to be a section of a pressure vessel. The force is equal to the radial stress at the point or points of contact multiplied by the sine of the gasket angle. This wedging force may be so great as to cause plastic deformation in the bolts holding the gasketed members together. If pressure is reduced in a vessel where this has occurred, the gasket will contract but the bolts will remain deformed and the joint assembly will leak. It sometimes happens, when using confined lens rings, that too much force is exerted on the gasket when making up the closure, and the gasket is permanently shrunk so much as to render it useless.

The hardness of lens-ring gaskets and the hardness of their seats are quite critical. German practice for a long time has been to make these gaskets glass hard, but such hard gaskets, in addition to not flowing, tend to dig into the seats and even to crack. The author's company has found that lens-ring gaskets seem to function best at hardnesses of R_c 44–48 with the seats relatively softer.

Modifications to Lens-Ring Gaskets. In addition to the common flat-surfaced and spherically surfaced lens rings, two modifications have come into some practice. One of these embodies a stiffening ring surrounding the actual lens ring, Fig. 10.

Gaskets of this type are widely used in Germany, but are not common in this country. In sizable applications, it was thought this stiffening ring would prevent the gasket from flexing. Actually, it appears to serve little purpose other than to make the gasket clumsy and expensive.

Another modification of the lens-ring gasket is the so-called hollow lens ring, Fig. 11.

The theory of this gasket is that pressure in the hollowed-out section will provide a bellows-like effect, thus allowing the gasket to follow very closely the contour of the vessel head. Hardness in these gaskets is even more critical than hardness in the ordinary lens-ring type.

It is usually specified that lens rings and lens-ring seats must be ground to extremely accurate tolerances. It has been the experience of the author's company, however, that lens rings and their seats, which are finish-machined but not ground or superfinished, are quite satisfactory.

One of the greatest advantages of lens rings is that the gasketed members need not be in perfect angular alignment, as with other types of self-sealing gaskets. This advantage, however, is less important in the sealing of vessels than in making pipe joints.

Wave-Ring Gaskets. The wave-ring gasket, developed by Imperial Chemical Industries in England, is another type of self-sealing gasket in moderate use. It is illustrated in Fig. 12.

Pressure is exerted on the entire inner surface, forcing a seal on the two outer radii. The gasket is usually made of soft steel, copper, brass, or some other moderately soft metal, although hardened-steel wave rings have been used successfully at very high pressures, or where vessels must be opened and closed fairly often. The gasket is seated, as shown in Fig. 13.

The gasket must be made slightly oversized, so that an interference fit is obtained in the seat, thus making the initial seal. No external force need be brought to bear on the closure for the purpose of effecting the seal. The degree of interference between gasket and seat may range from 1 part in 2000 to 1 part in 10,000.[1]

Wave-ring gaskets give satisfactory service where a vessel need not be opened often; but where a vessel must be opened numerous times, they are somewhat impractical as they sometimes become so tightly wedged that vessel heads can be removed only with extreme difficulty. When this jamming occurs, the gasket usually must be discarded, as its crests have been flattened and scarred. A group of formulas for the design of the wave-ring gasket,[2] have been developed and used fairly widely but these are purely empirical and lead to the rather questionable assumptions that extremely wide thick gaskets are necessary for high-pressure work. Actually, dimensions of wave rings may vary quite widely, and the gaskets still function properly. The chief precaution in their design is to avoid making them so thin that, under pressure, they will burst through the trough between the crests.

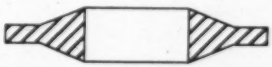


FIG. 10 STIFFENING RING SURROUNDING LENS RING

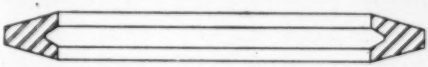


FIG. 11 HOLLOW LENS RING

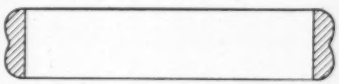


FIG. 12 WAVE-RING GASKET

FIG. 13 (*left*) SEATING FOR WAVE-RING GASKET

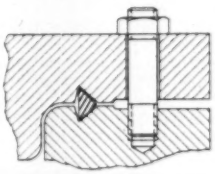


FIG. 14 DELTA GASKET IN SEAT

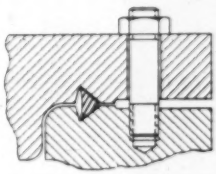


FIG. 15 DELTA GASKET DEFORMING UNDER PRESSURE

Delta Gasket. The newest type of gasket to come into wide use in high-pressure applications is the delta gasket, so named because of its equilateral-triangular shape, Fig. 14.

This gasket was developed by du Pont about 14 years ago, but its design has only been public for about 3 years. Being designed from the lens ring, it is self-sealing after an initial seal has been made. The gasket seats on two points of the triangle and deforms as shown in Fig. 15. Pressure causes flexure of the

[2] W. M. G. Manning, "Conference on Jointing and Packing," Society of Chemical Industries, Chemical Engineering Group, 1937.

triangle around the two seating points so that its inner face tends to assume a curve and a seal is made at the points and along the upper parts of the legs.

This gasket is considered by many authorities as the most generally satisfactory type of high-pressure gasket now current. It embodies all of the desirable features of the self-sealing gasket and none of the undesirable features of the lens-ring or wave-ring types. It is fairly inexpensive to make, easy to seat, and will not cause the vessel head to stick. Because the slope of its sides is much greater than the slope of the sides of a lens ring, the wedging force on the vessel head resulting from its use is of little importance, and only a very small force is required to bring about the initial seal. Except for a tendency to crack when extremely hard, hardness presents no great problem for this type of gasket. For fairly low-pressure applications (10,000 psi), moderately soft metals, such as the 300 series stainless steels, or low-alloy steels, seem to give best results. For

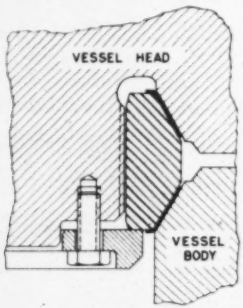


FIG. 16 TYPE OF GASKET FOR LARGE PRESSURE VESSELS
(German double-cone joint.)

higher-pressure applications (50,000 psi or more), harder materials, such as high-alloy steels or the 400 series stainless steels, appear to give better results, although softer materials have been used successfully in small applications, at very high pressures.

Other Types in Use. This discussion is intended only as a description of those gaskets and closures in common application in this country for sealing high-pressure vessels, but it by no means should be inferred that these are the only types of gaskets and closures extant. There are many more which are in use to some degree; some are quite satisfactory, others not so satisfactory. A type of closure quite common in Germany, but which does not seem to be used on American-made vessels, is shown in Fig. 16.

This design appears to have all of the features of a good closure. It is self-sealing, cannot cause a vessel head to stick or wedge, and its elements are not too complex. The gasket is made of a mild or semihard steel, and the seating surfaces are covered by thin sheets of aluminum or copper so that a relatively small force need be put on the head to cause initial sealing. The closure was designed specifically for use in large vessels and does not seem to be advantageous for small vessels. The slots in the head under the gasket are to relieve the gasket, should it tend to collapse under the force which must be exerted on the head to balance the pressure in the vessel. The retaining ring holds the gasket in place when the closure is being assembled. Although somewhat more complex than the delta gasket, this closure, nevertheless, might give excellent service in some installations in this country, and bears further investigation.

GASKET PROBLEMS

The problem of failure in gaskets, due to fatigue, is one of some importance. The higher the pressure and the more variation in pressures and temperatures to which the gasket is subjected, the more critical the problem becomes. To the best of the author's knowledge, to date there has been no reliable work done, giving quantitative results on fatigue in gaskets functioning at high pressures. The problem, if reduced to quantitative terms, would be quite complex, since both elastic and plastic

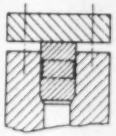


FIG. 17 GASKETLESS LAPPED JOINT

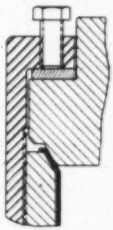


FIG. 18 CLOSURE USING A SOFT LINER TO ACT AS A GASKET

fatigue effects would have to be taken into consideration. Qualitatively, it is known that failure in self-sealing gaskets (lens rings, delta gaskets, and others) due to fatigue, is more common than failure in confined flat compression gaskets, perhaps because self-sealing gaskets are more likely to be used at higher pressures than flat compression gaskets, and more important, probably, because self-sealing gaskets tend to flex with changing pressure.

To eliminate the effects of fatigue and the necessity for bothering with gaskets at all, the gasketless lapped joint has come into some practice recently in small high-pressure installations in spite of the extreme tolerances which must be maintained. A simple arrangement of this type is shown in Fig. 17. Actual sealing occurs on the taper, which tends to lock.

Another related closure, utilizing a soft vessel liner to act as a sealing surface, is shown in Fig. 18. Here, lapping is not necessary, but if the closure is not designed properly or too much force is put on the vessel head, the liner may extrude from the vessel at the seal.

One caution always to be kept in mind when using any type of high-pressure joint is to prevent a scratch from running across a sealing surface; i.e., from inside to outside. This will make the joint ineffective, since even though some deformation is encountered when pressure is applied, it is usually not enough to eradicate or fill the scratch. The scratch then acts as a passage for pressure to leak through.

CONCLUSION

In conclusion, concerning the problem of the high-pressure joint, it must be said that if a rigorous study, utilizing the principles of elasticity and plasticity could be made, it would be of inestimable value; but so many variables are involved that such a study would be too complex for any but the most ambitious researcher to undertake. Such studies have been begun, but their results always have been obscure. To be feasible, even from the strictly mathematical point of view, such studies of necessity must make many assumptions concerning the variables, and the answer obtained is only as good as the assumption made.

At present, even for the simplest types of gaskets, there is no completely reliable design criterion, based on anything other than experience. As is true in so many engineering problems, there is just no adequate substitute for the experience and judgment of the designer.

GUIDE POSTS *to an* ENGINEERING CAREER

By C. G. A. ROSEN

CONSULTING ENGINEER, CATERPILLAR TRACTOR COMPANY, PEORIA, ILL. FELLOW ASME

INTRODUCTION

FORTUNATE is the man who has oriented his directional tendencies. His life has a purpose; he is drawn as if by an irresistible lodestone toward the pole star of his career.

I am not an interviewer nor an employment counselor. For many years I have been associated with young engineers and their problems and I am intensely interested in the welfare of the engineering profession. I hope I can utilize the years of my experience to cast some light on the present confused situation.

It must be tremendously confusing to engineering seniors to have five or six industries clamoring for their services. How different this era from the one in which I embarked as a young engineer forty years ago. Today the engineering graduate is a pearl of great demand. In my day getting out of college was a different kind of challenge—it was the day of "Root Hog or Die."

What changes have been wrought by the miracles of the engineer! In my own time, for instance, I have seen the great fleet of bowsprits of sailing clippers on the Embarcadero of San Francisco disappear as if by a magic wand, giving place to the dominance of the steam-turbined ocean liner and the great Diesel-motored freighter. Similar Aladdins have caused the horse and buggy to yield to the automobile, the captive balloon to the airplane.

The era of electronics has achieved the measurement of infinitesimal forces, the feeblest velocities, and the most transient phenomena. Recently the Atomic Energy Commission announced the development of an atomic clock measuring time in a fraction of a billionth of a second. The Navy has shown photographs of the ocean's bottom taken at 3600-ft depth by Sonar. The engineer has achieved a major part in all this, a product of his brain and will.

Yet, we live in a difficult age, an age of utter contempt for the economic lessons of history. History proves that we are more successful in building enduring bridges than in building a lasting society. Bridges are easier to build. The Tower of Babel was a magnificent engineering achievement, in the ancient world, but its social implications led to confusion and chaos.

Perhaps in this present era, with our attention drawn to our vaunted technical skills, we have a similar confused situation.

On this vehicle of progress on which we are traveling, the trained engineer is definitely at the throttle. That is as it should be, but the dispatcher, who sets the signals or determines the right-of-way, is the politician. Despite the potential distance-covering capacity of our progress, the actual velocity of travel and the arrival time are controlled by the whim of the men we elect to mold the course of our society.

These two functions have been all too long at loggerheads, and the day is fast arriving when co-ordination of purpose must be consummated or we will wreck the whole power plant of progress.

The failure of statesmen, politicians, economists, and society itself to handle the problems of an ever more-compressed, ever more-active world society, has resulted largely in diverting our efforts as engineers and scientists from the problem of making better things for better living, to devising methods and manufacturing weapons for the more complete and rapid annihilation of the human race. To arrest this process of destruction the young engineer must be prepared to step into larger fields of social activity than are ordinarily envisioned as the fields for technologists, engineers, and scientists. That is why he has a responsibility to his profession, to maintain its progressive growth as well as to society, to solve the problems which deter the achievement of that growth.

I would urge that mechanical engineering be thought of as a profession, not as a job. Cultivate the habit of dignifying this career as a professional activity as would a surgeon, or an attorney, or a professor. We belong to an international brotherhood. Engineering speaks a universal language and is a meeting ground for every race and creed. The warmth of fellowship in a common cause is a genuine satisfaction when we are called upon to speak to some foreign engineering society and serve our professional brothers by revealing the accomplishments of our endeavors. I know this to be true because it has been my privilege to speak at meetings of The British Institution of Mechanical Engineers, the German Verein deutscher Ingenieure, The Swedish Association of Engineers, and The Royal Dutch Engineers of Holland.

A PROUD HERITAGE

We, as engineers, have a heritage of which to be proud, a standing in world prestige worthy of the achievements of our members as professional men.

In thinking of the future of our profession, I am reminded of an experience in Panama some years ago. While standing on the mountains of Darien, I could visualize the explorer Balboa beside me as he caught his first view of the great western ocean. He named it "Pacifico" because of the calm and peaceful character of the clear blue waters.

Balboa had experienced the turbulent Atlantic with its running seas 55 ft high, but he could never imagine the typhoons and equinoctial storms which often vent their fury in the Pacific. Likewise I can bring to the reader lessons of past experiences, but the crystal ball doesn't define the future too clearly. Yet in the words of Samuel Johnson, "The future is purchased by the present." I know of no better way for engineers to assure a future than to join wholeheartedly now in the full utilization of their scientific training for the common good.

As engineers, thinking straight and acting diligently, we can find a venture to pursue, of which we are so deeply persuaded that we will be willing to stake our lives upon it. This attitude we must espouse if we are to gain the durable satisfactions of life. Such faith is neither certainty nor credulity, but courageous trust.

Address delivered to the undergraduate students of the College of Engineering, University of Illinois, Urbana, Ill., on the occasion of their "Career Conference," March 30–31, 1952.

MECHANICAL-ENGINEERING PROFESSION IN PERSPECTIVE

Permit me to scan the mechanical-engineering profession in perspective. In this discussion I have amplified my own experience with the experiences of representatives of three large industrial enterprises and three smaller manufacturing companies.

A series of thirteen questions have been given me as a guide in this deliberation. It is my understanding that these thirteen questions are of the type asked by students at previous conferences. Eleven of them were asked of R. E. Peterson,[1] Manager of the Mechanics Department of Westinghouse Research Laboratories, at the 1951 Career Conference.

His clear answers and elucidating discussion of these questions are well fortified with graphs and supporting information. I commend his paper[1] to the reader for careful study. I will not repeat his arguments but will strive to uncover a fresh viewpoint based upon the premise mentioned previously. I recognize that my analysis can reflect a different plan of approach.

The national economic trend indicates an even greater critical situation with respect to increasing job opportunities for college graduates. In going to the same source of information as Mr. Peterson for facts, but of a year's later survey, I find in a paper by Dean Hollister, "The Engineers Shortage Continues," that there has been no appreciable increase in the percentage of high-school graduates desirous of entering the study of engineering, and that early in June, 1951, the Engineering Manpower Commission made a survey of 378 companies and government agencies to determine the immediate need for engineers. The result of this survey indicated a total national need of 80,000 engineers, quite independent of those needed in uniform. Against this need there were graduated 38,000 men, half of whom the Manpower Commission determined by survey were committed or subject to military duty. The unfilled demand as estimated by industry was, therefore, 60,000 by the end of June, 1951. By the end of June, 1952, this figure had been estimated by various authorities to have increased to 75,000 to 100,000.

What is the outlook?

1 There is a wholly inadequate supply of engineering graduates to meet even the most ultraconservative estimate of a need of 30,000 per annum to fill replacements and expansion.

2 At present enrollments, with no withdrawals of engineering students for military services, there will not be enough graduates between 1953 and 1961 to meet the peacetime need by at least 20 per cent annually.

3 The industrial and governmental civilian need for engineers was far greater than the graduating class of 1951, when 38,000 were graduated, and for 1952, when 25,000 were graduated. Whatever the military requirements for engineers may be, they are not available in any year we can foresee except by taking men from industry, thus further intensifying the needs of industry.

4 The first step toward bringing need and supply together will be through spreading the engineer's work over a greater range and, thereby, lessening the need.

All this sums up to the fact that it does not now appear, by any present or likely pattern of utilization or available source of supply, that need and supply will be brought into balance over the next decade.

This pertinent situation has come to the attention of the government, and a policy group has been formed within the Research and Development Board of the Department of Defense to assist in the effective utilization of scientists and engineers from industry and universities.

[1] "Discussion of 13 Questions Asked by Students," by R. E. Peterson, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 487–491.

The technical personnel service manager of one large company viewed the situation in these words: "In fact, in the general sense at least, as far as engineering is concerned I doubt that we shall ever again have a surplus of engineering graduates. We must and will learn how to use them more effectively; and perhaps this will mean, for some engineering graduates who are not really professional in caliber, industry may have technician-type jobs rather than professional jobs." The personnel director of a small company states, "The world situation, the arms program and other factors responsible for increased industrial expansion indicate steadily increasing job opportunities for college graduates."

Another small company president says, "Most emphatically there is a definite economic trend increasing job opportunities for college graduates." Another large company reports, "It is our opinion that the next four or five years will be a period of tremendous job opportunities for graduate engineers. There may be some ups and downs after that, though with the rapid development of science and invention it seems that we will probably never see a permanent glut of technical people in the foreseeable future. This, of course, does not mean that there might not be two or three years, from time to time, when everything is in excess supply."

Another contact man with universities, from a medium-sized company, states that he "expected his group to interview 300 men in 1952, and hoped to be able to secure 100 of them for engineering classifications."

The increased complexity of our industries and the development of new technological areas such as atomic energy, antibiotics, jet propulsion, electronics, and so on, have caused a definite increase in the use of engineers and scientists quite independent of mobilization. The ratio of engineers to direct labor has been increasing steadily since 1890. It now stands at about 1600 engineers per 100,000 workers, according to the Bureau of Labor statistics.

Perhaps the brief summary made by Carey H. Brown, chairman of the Engineering Manpower Commission of the Engineers Joint Council, summarizes the whole situation as we see it today: "Engineers are essential to the defense effort and to our industrial future. Engineers are in short supply. Engineers must be utilized to the maximum possible extent—the engineering pipeline must be kept full—adequate supply of this critical element of America's manpower is essential."

All this adds up to the fact that engineering graduates are definitely wanted in industry. The essential matter to consider, however, is that the graduate make himself qualified and continue to improve that qualification for the long pull ahead. We hear a lot about security today, security by doles, security by government handouts, and security "from the cradle to the grave." To live securely with satisfaction and a sense of achievement, the best possible security is to continue to be wanted. The engineer will never lack for opportunities throughout his career as long as he is in the position where someone needs his services.

WHAT ARE SOME OF THE ASSETS AN EMPLOYER SEEKS IN NEWLY GRADUATED STUDENTS?

Perhaps it would be well to look at the product turned out by the educational institutions. According to Dean Everitt of the College of Engineering of the University of Illinois, the objectives which are now universally accepted in university teaching are as follows:

1 Teach to think.
2 Teach fundamentals.
3 Teach to achieve action.

Professor Highet of Columbia University has expressed the

viewpoint of the teacher with regard to the importance of logical thinking: "The best teacher in the world cannot force the student to grow in mind to his fullest powers, all that he can ever do is to help and to encourage; his best reward is to see not a product but a free and independent human being who can think."

Mr. Peterson of Westinghouse has formulated a graph showing the executives' rating of desirable personal characteristics of general engineers. He lists clear thinking as conspicuously on top and, most important, with imaginativeness next. Closely following he lists co-operativeness, truthfulness, high principles, and stability.

The supervisor of training of a large industrial enterprise states, "We select students principally on three items: grades, personality, and activity." An executive of a small company lists the following as desirable attributes of newly graduated students:

(*a*) A realistic understanding of the American system of free enterprise.

(*b*) Principal concepts of the field of endeavor for which his college training has prepared him and in which he will work.

(*c*) Ability as well as desire to assume increasing responsibility somewhat in proportion to length of service with the many attendant qualities this infers.

The foregoing is perhaps more definitely related to the requirements of a small company, for another large company lists the qualifications as: "Basically, industry is primarily concerned with a man who can get a job done both now and in the future. All of the other commonly listed assets are really contributory to this basic requirement rather than requirements in themselves."

The employment manager of a small company lists the assets he considers essential as "evidence of capacity for development, of positive character, of intellectual honesty, of social abilities, favorable appearance and personality and of probable professional or technical competence." He was thinking primarily of sales and service engineers.

A manager of the education and training department in a medium-size company states, "First of all we look for character when interviewing a new applicant. We feel that this is more important than any other one item. Secondly, he must have the education and background to fit the particular assignment that we may have in mind. For instance, if a man specialized primarily in time and motion course studies, it might be rather difficult for him to fit into a research department."

It would seem from these answers that the larger companies depend on building upon the fundamental characteristics built into the man and then developing the man to suit the requirements of some specific duty. The smaller companies take into consideration the over-all aspects of training given a man at college.

Further evidence to support the basic asset of being thoroughly grounded in fundamentals is a survey conducted by Dean Freund of the College of Engineering, University of Detroit, in analyzing a survey of former students as to what studies were useful in employment. The percentages of the total men reporting show how studies have been of use in their careers:

(*a*) Habits of accuracy and thoroughness, method of thinking, creative ability, and so on—71 per cent.

(*b*) Understanding of the principles of the physical sciences, mathematics, chemistry, and physics—71 per cent.

(*c*) Skill in drafting, computing, testing, use of instruments, and so on—58 per cent.

(*d*) Information about techniques, organization, and practices of engineering, manufacturing, construction, and so forth—38 per cent.

(*e*) All others than those listed in the preceding tabulation—28 per cent.

With reference to the value of being thoroughly grounded in fundamentals, I would like to recite a story of an experience with a Scottish engineer in Java. This engineer was sent out to establish power plants and build all of the manufacturing and construction facilities for producing coconut oil in the Dutch East Indies. It would have been impossible for him to carry complete handbooks and technical encyclopedias to cover all of the subjects which would be placed for action under his decision. Yet this engineer was so thoroughly trained in fundamentals that he did not find it necessary to carry handbooks or textbooks into the jungles in order to solve the problems which he faced. In every instance his knowledge of fundamentals was so good and so accurate that he could sit down and develop the basic formulas which he required to evaluate his problems.

The preceding discussion has dealt with the general requirements of men seeking graduates of mechanical-engineering colleges. There are specific requirements which are often demanded with reference to specialized training for research or particular characteristics necessary for sales engineers. Manufacturing and production may have other specific characteristics which they list as pre-eminently necessary, but in no case would it be desirable for anyone to minimize the assets of clear thinking, of dynamic action, and of high principles. If a man has these basic qualifications, the training departments in most large companies have the raw material with which to mold a man to suit requirements of their organizations. In smaller companies there may be the necessity of advising a man to move on to another organization where his specialized characteristics may have freer opportunities and larger scopes of influence.

DO EXTRACURRICULAR ACTIVITIES HOLD MUCH WEIGHT?

A large company expresses its view, "An employer is interested in balance. Naturally he would prefer to recruit a man with top grades and also with outside activities." However, most employers do give considerable weight to grades. In most cases, however, grades cannot measure a man's entire personality and his basic ambition and ability to get things done. Employers, therefore, look to other measures of these characteristics, and outside activities is one of the best measures.

In the opinion of another company, extracurricular activities are given moderate weight only. The executive of a small company states, "A well rounded individual, that is, one with average grades and extracurricular activities, ordinarily wears better, can meet varying conditions more easily and is to be preferred." The supervisor of training of a large machinery division states, "The answer to this question depends upon the job and the man. In general, people whom we want for sales should be of a type that gravitates easily to activities of an extracurricular nature. For research and development one should certainly have high grades."

Mr. Buckley, president of the Bell Telephone Laboratories, has stated, "As the problems of government increasingly involve technical affairs, the engineer will be given the opportunity to participate increasingly in public affairs. Just as engineers in industry have had administrative responsibility thrust upon them, so will engineers be drawn into administration of public affairs. There are many ways in which they can serve, but to be effective they must gain experience with human problems as they have learned to deal with physical problems. Wherever they serve, their outstanding good qualities, especially their objectivity and honesty and their sense of responsi-

bility will win for them acclaim. How rapidly they rise and how much they can contribute is in the hands of the engineers themselves." The unquestionable evidence of the increasing consciousness of public responsibility outside of their technological realm is one bright ray of hope for the future of our country.

Our world of today is infected with the curse of dictatorship. This disease is not in Russia only. We find it in government, we find it in business, we find it in labor unions. Among engineers of different skills we know that co-operation is a powerful tool in the effective operation of an industrial enterprise.

Efforts toward extracurricular activities should be directed toward clarifying a vision of the future as to its tremendous technical possibilities. If the engineer is to educate the lawmaker and the voter, he must learn how to tell his story in terms of values which can be understood by the layman. The big problems of industry today are largely due to the public's lack of knowledge relative to the economic impact of technical progress. An engineer's interest and responsibility must embrace economics, politics, security, and public affairs. He must be fully aware of the impact of his profession on the life of the community.

WHAT TYPE OF WORKING CONDITIONS MAY ONE EXPECT?

A small-company executive states, "Working conditions in smaller companies may be less satisfactory than in larger companies, although examples to the contrary may be cited." Actual observation of the companies under consideration by the young engineer candidate is probably advisable in order to answer this question for himself. The training supervisor of a large company says, "There are many variations to the type of working conditions which a man might logically expect. It is our opinion, however, that since colleges make little or no effort to give their students practical knowledge, the student has a right to expect a good training course or at least a good period of orientation on the part of his employer." Another small organization says, "In the smaller organization, organizations and functions will be less clearly defined, and a great deal more informality will be found with respect to all phases of the employment. There will be fewer guarantees and possibly more varieties of opportunity for the individual to exhibit his particular values. There will be correspondingly obvious disabilities, making it difficult to say that one situation or another is better, and in the last analysis the answer will depend on the individual and his capacity for adjustment."

A large industrial personnel-service manager states, "In larger companies engineering graduates are carefully trained before being placed in a particular assignment, and are considered to be potential professional engineers from the first day of their employment. Nearly all organizations expect engineering graduates to be able to produce, to some degree, with their hands as well as their heads. However, the ultimate value of the engineer is in his technical, analytical, and creative abilities, which are largely mental."

Finally, a young engineer should strive to develop intellectually even beyond the confines of the technical field. He should constantly strive to discipline his mind. This means a life of continuous study, with time allocated at positive intervals each week for mental discipline, not just thumbing through magazines or looking at pictures and casually reviewing the headlines, but actually doing the thing that is necessary to discipline oneself in analyzing and understanding the subjects which are being read. He should occasionally review the old textbooks and "bone up" on fundamental principles, to keep sharp and alert in his capacity to meet problems, and to be available to serve when the supreme opportunity arrives.

ARE THE LOCATIONS OF JOBS IN THIS FIELD LOCAL, REGIONAL, INTERNATIONAL?

Engineering opportunities today are almost unlimited with respect to location. Probably the majority of engineering positions in the country are concentrated in the Northeast section, in the Chicago-Detroit-Cleveland triangle, along the Gulf coast, and along the Pacific coast. The greatest variety of engineering jobs is probably in the first two of these areas. Most of the international opportunities are in the more industrialized countries, except in the maintenance, operating, and marketing functions. In these functions jobs may be found in almost any country. Even a small manufacturer reports, "There are locations of jobs in his field in local, regional, and international locations." Another large manufacturer reports, "Most company jobs are local and regional with some international jobs." It is the opinion of many executives that anyone in the engineering profession should be prepared to move around from time to time if he wishes to advance. This is true whether he stays with the same company or moves to another. Branch offices, new plants, foreign bureaus require key personnel from headquarters. A small manufacturer states, "Relatively few small companies do an international business, although many which are manufacturers carry on country-wide trade and offer jobs in widely separated locations, which are constantly being expanded beyond the boundaries of the United States."

SALARY EXPECTATIONS IN THIS FIELD

In averaging the replies of the six companies comprising this survey, the salaries were currently within fairly close agreement depending upon the type of work and the applicant's qualifications. The median salary for all six companies averaged $312.60 per month as a starting salary. The estimated appreciation was from 10 to 15 per cent per annum as the engineer progressed in his growth in the organization. One large company states, "The average engineer of 45 years of age is at present probably receiving about eight thousand dollars." This is, however, a poor indicator of what current engineering graduates may expect to receive when they themselves are 45 years of age. It is important to realize that as a man achieves in his profession, there comes a time when he will break through the ceiling of average salaries and range in the rarefied atmosphere of authority, bringing commensurate compensations financially. It is also known that some engineering executives in this latter classification are receiving better than $25,000 yearly.

The limits of salary compensation are the limitations of the man himself and his ability to serve with his talents and energy. It is well to remember that money alone will not produce happiness.

WHAT ARE THE CHANNELS BY WHICH ONE MAY PROGRESS IN THIS FIELD?

There is a wide variety of possibilities; much depends on the organization, the individual, and his preferences. A training supervisor states, "There are three ways one can progress in the engineering field. One is by getting on the chain-belt sort of system, keeping your position and gradually riding up on the simple fact of having the top people retire or die. Another way is by being so capable that you 'leap frog' past your contemporaries. A third way is to get into a growing company or a growing department which, due to its rapid expansion, automatically makes good jobs. This expansion might or might

not be due to your own activities in that particular sphere."

A large-company representative says, "The answer to this question is almost directly related to the characteristics of the particular company and the industry involved. It also is greatly dependent upon the interest of the individual, how his abilities and interests are primarily concerned with technical matters or, if he will, as he gains experience gradually, develop interest and corresponding ability in supervisory areas. Nearly all engineers may expect to be asked to fill rather simple engineering assignments at first. In general it will probably be some years before they move from a technical-type job to a first-level supervisory job even if their interest and abilities lie along these lines. However, with a very small company where the engineering content of the product is small, an engineering graduate might have supervisory responsibilities almost immediately."

The executive of a small company cautions, "In the smaller company ability in one's field of endeavor is the principal channel, whereas, in the larger company ability may go unrecognized if one does not, or cannot, play the essential politics." D. S. Kellogg,[2] chief engineer of Maxson Engineering Division, The W. L. Maxson Corporation, states, "The necessity to get things done will remain as long as there is human life on this planet. The ones who succeed will always be the ones who can get things done." This perhaps is the gist of the entire argument in its simplest terms.

IS IT BETTER TO START WORKING IN A SMALL OR LARGE COMPANY?

A small company generally provides the opportunity to acquire a broader knowledge earlier, since there is less specialization. However, it cannot be said that the wider horizon in itself provides more practical knowledge or less practical knowledge than does the more restricted scope in the larger company. Practical knowledge can be obtained in either a small or large company. However, some small companies have no sense of responsibility with respect to developing professional employees. They have so few they do not feel they can devote any time or energy to developing those they do have. Larger companies, particularly those whose success is based in large part on the engineering content of their products, cannot continue to succeed without considerable attention to the development of their professional employees. If a man feels completely self-sufficient, has tremendous initiative, and is willing to take his chance in a more "rough and tumble" situation, he can probably move more quickly, particularly in the beginning, in a small company. However, if a man feels he needs some understanding of the industrial job, needs to obtain more practical knowledge before he is called upon to use such knowledge, wants some guidance in his development, then he can probably develop more rapidly in a large company.

The employment manager of a small company states, "A competent individual will have no problem in acquiring adequate practical knowledge in either a small or a large company. In the small organization such knowledge may be acquired early and perhaps more rapidly, but, in many cases, there will be compensating disabilities for such advantages, as is true as well in the in-line process in the larger organization."

DO MOST COMPANIES HAVE THEIR OWN TRAINING PROGRAM FOR COLLEGE GRADUATES?

The training program, if one exists, in a small company is not necessarily set up for incoming college graduates alone. The frequency of hires must be sufficiently great to keep the program active and to make it worth while both for the company and the new employee. Most of the large companies, large with respect to the number of new engineering graduates employed each year, have their own training programs for college graduates. Some smaller companies do have their own training programs, but the total number of such programs is small when compared with the number conducted by the larger companies. One small-company executive states, "Those who employ graduates for development purposes, will have some programs, formal or informal, depending upon objectives and other factors, which are related to the specific development program. These can be regarded often as the equivalent to the formal organized type of training programs set up in larger organizations for specific training."

Smaller companies are becoming more and more conscious of the need of indoctrinating college graduates into their organizations by some form of training program. This is proving to be successful by carefully selecting the field which is most comfortable and most advantageous in which to place the college graduate, thereby giving him a real opportunity to develop and grow.

HOW DOES THE GRADUATE ENGINEER SEEK EMPLOYMENT?

Under conditions prevailing today, there are probably five available employment opportunities for each mechanical-engineering graduate. The problem of seeking employment is how to select the company for which one wishes to work, instead of trying to obtain employment as such. The procedure I would recommend is as follows:

If one desires to work for a small company, he should select the industry in which he is most interested. Then make inquiry of the industry trade association for names and addresses of its members. Next, make application directly to desirable companies, get the best counsel available on possibilities, probable best lines of endeavor, and job-getting techniques. Determine also an alternative preference in keeping with a realistic appraisal of individual assets, and relate them to the general employment situation of those companies. If possible, visit two or three of the companies and make a selection on the appraisal of which company satisfies one's desires most completely in terms of long-range values.

With large companies in mind a student should certainly discuss his employment interest with college faculty members whose specialty is in the area in which the student has a primary interest. He also should review material available with respect to companies employing engineering graduates, and through this process narrow the field to two or three companies. He would then do well to obtain from the college a list of alumni employees in those companies and to write to men who have been there a few years, asking questions about the opportunities and type of work available. He should further interview the representatives of as many of these companies as possible when they visit the college campus.

With job opportunities as plentiful as they are today, the graduate must take more responsibility on himself for proper placement. Wherever possible he should visit the companies in which he is interested and find out all he can about the company and the community before making his decision.

ADDITIONAL TESTS TO APPLY

If a decision is uncertain, or difficult to make, after following the afore-mentioned procedure, there are five additional tests which might be applied, any one of which may reveal the deciding factor. Answers to these questions should be analyzed carefully with the assistance of a very competent consultant:

(*a*) Evaluate the status of three or four alumni who have

[2] "Are Engineering Graduates Prepared for Their Jobs?" by D. S. Kellogg, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 572–575.

been out of school working for the company for about 25 years. Ask them if they are satisfied with their status and opportunities to achieve; does their outlook place the company in a satisfactory position where capable engineering talent is given the chance to develop and receive its due rewards or place in the affairs of the company?

(*b*) Review the organization chart to determine if top engineering controls are vested in the hands of lawyers or financiers, or a selfish dictatorship of engineers to the detriment of engineering progress. Most progressive large companies break the engineering personnel into a number of triangles of authority, each with its division head. All such sublevel triangles are then made subservient to one top-level triangle of authority with its top engineering executives. In this way the growth of an engineer is assured in the subtriangle levels to the achievement of a head position, after which further opportunities may prove available in the top-level triangle. On the other hand, an organization which has only one triangle of authority poses the problems which arise in the midtriangle jamb at 30–35 years of age and often result in disappointments and displacement of men.

(*c*) Determine, by guidance if possible, the company's ability to utilize its manpower effectively.

(*d*) Determine the mortality rate of engineering graduates and the reason for losing men to other companies after completing the formal training period. Over a twenty-year period the mortality rate should not be over 40 per cent.

(*e*) Are there opportunities for continued study in factory courses, or postgraduate university training to achieve additional stimulation and broadening of capacity, commensurate with outstanding personal achievement?

This procedure may appear complicated, but the process is suggested as a step-by-step method of analysis in view of the present confusion which exists in the minds of many who expect to be candidates for employment in industry.

IN WHAT FIELDS OF MECHANICAL ENGINEERING DO MOST OPPORTUNITIES FOR EMPLOYMENT EXIST?

The paper by Peterson[1] shows in Fig. 2 a revealing barograph. This graph illustrates far better than any descriptive material that, in the present period, mechanical engineers are required in almost all kinds of business. Mechanical engineers probably can find good jobs in almost any area of engineering activity. An engineering career under present conditions of scientific growth should give a man a very strong sense of belonging to the trends of the times. Of particular value are those who do not consider themselves specifically as mechanical engineers so much as they do engineers. Broadly speaking, industry does not in the last analysis employ particular kinds of engineers, but engineers as a group of men who can do engineering jobs whether they involve mechanical, electrical, or a mixture of several branches of engineering. In a recent paper, A. P. Adamson[2] of the Aeronautic and Ordnance Systems Division of General Electric states, "Where is the boundary between electrical engineering and mechanical engineering? Your attitude on this question will have a profound effect on your future progress as an engineer and on the future growth of the mechanical-engineering and electrical-engineering professions. I am going to try to convince you that there is no boundary. Furthermore, if there is really no boundary you can feel free to attack any problem that appeals to you." He continues further, "Start thinking of yourself as an electromechanical engineer. This will enable you to build up the proper mental attitude so that you won't start quivering all over when faced with the necessity of incorporating a vacuum tube in a piece of equipment you are designing."

The supervisor of sales training in one large industrial concern states, "Currently the principal drive is for production and design people. I might make a comment, however, that sales-engineering jobs are sometimes underrated. I suspect that some highly satisfactory careers in sales engineering might often be overlooked." The executive of a small company states, "As my interest is principally in heating and air-conditioning I can only say opportunities for mechanical engineers are constantly increasing in this field."

A survey of the graduates hired by the author's company in 1950 for their one-year training program is of interest. Out of a total of 46 college graduates, 27 were mechanical engineers, one an electrical engineer, nine agricultural engineers, two civil engineers, six metallurgical engineers, one chemical engineer, and ten others chosen from general college courses. The mechanical engineers went into research, engineering, service, merchandising, general sales, export sales, and engineering sales. Of the total, twenty-two went into engineering and research, twenty-one into sales and advertising, seven into production, two into purchasing, two into service department, and one into community relations.

These facts reveal that training for mechanical engineers fits a wide diversification of employment in industry.

WHAT ARE THE NEW DEVELOPMENTS IN YOUR FIELD, AND ARE THERE ADDITIONAL REQUIREMENTS?

Generally speaking, the new developments that have come along in our era have required greater and greater knowledge of the fundamental principles of science rather than specialized knowledge. A large manufacturer states, "In the field of atomic power, in working with nuclear piles and nuclear reactors, the mechanical engineer is called upon for a much better understanding of the fundamentals of heat transfer and fluid flow than he ever has had before. It is much more important that he know how to attack problems in this field than it is that he know some of the specialized information in nuclear physics. As a matter of fact, the principles in nuclear physics are fairly simple; the real problems are those of design and metallurgy, which have always been the major problems in mechanical engineering."

New trends are numerous. For instance, all of us are most interested in gas turbines. The current problem of burning low-cost fuels is definitely related to blade structure, blade material, blade velocities, and efficiency. The Diesel has much development work to be done to bring it to the high stage of competition into which other prime units are forcing it. We have with us four systems of combustion in current types of commercial engines. This is a stigma of ignorance revealing the inability to develop one outstanding means of providing mixture formation of air and fuel. The problems of supercharging are very imminent and real. The Diesel engine is an excess-air engine and thrives on excess air. Supercharging is a natural, but today's developments are hampered in utilizing the native ability of an engine to consume larger quantities of fuel because of the inefficiency of the superchargers.

The subject of heat transfer has been with us for many years, yet we still find our present methods and means of controlling heat channels far inadequate in relation to the heat flows imposed on concentrated areas.

Brigadier General David Sarnoff, chairman of the Board of Radio Corporation of America, recently said, "All my life I have been fascinated by the tremendous forces that can be harnessed for the good of mankind, and have been more interested in what can be built than what has been built. There is great stimulation and satisfaction in looking for new fron-

[2] "Take a Broad View of the Scope of Your Profession," by A. P. Adamson, MECHANICAL ENGINEERING, vol. 73, 1951, pp. 649–650.

tiers of the mind that point the way to human progress. Columbus in seeking a route to the Orient discovered a new world—so engineers working on a specified project have come upon unexpected new worlds."

Goodyear accidentally spilled a sulphur-rubber mixture on the kitchen stove and invented the process of hot vulcanization of rubber. Carothers created nylon as a result of his pure research efforts to create giant molecules. More recently, Sir Alexander Fleming, the English bacteriologist, discovered penicillin in a project on influenza, when some mold accidentally got on his culture plates and created a bacteria-free circle around itself. The new frontiers are the frontiers of the mind.

WHAT SATISFACTIONS BESIDES SALARY MAY ONE EXPECT TO GAIN FROM JOBS IN ENGINEERING?

Permit me to answer this with a final word to young engineers regarding professional self-development in the engineering world. The question that is ever in the minds of young engineers is: "How can I plan my career to achieve success in the engineering profession?"

The composite of the ideal engineer is a stature of many facets. His qualifications may well be expressed by the example of Leonardo da Vinci. This medieval Florentine genius was peculiarly endowed. He possessed the observing eye of the painter and sculptor, the penetrating faith of the philosopher and religionist, the cold deductive logic of the mathematician, and the enterprising spirit of the inventor.

A phenomenon in Nature commanded his undivided attention, impelled him to believe that a reason was behind its existence, and that a useful end was its purpose. He invited the aid of mathematics to establish a law for its control and duplication, and inspired inventive effort to apply his garnered information to practical performance.

His name is immortal. If he would speak to us today, I am sure he would disclose the underlying motif of many an illustrious engineer: "Seek ye ever the knowledge of fundamentals and all these other attributes will be added thereto."

And what are these fundamentals? The first, I think, is: "The constant discipline of the mind." And the second: "The enthusiastic will to serve."

The "will to be of service" makes a catchy slogan. I wonder how much we cultivate the "will to do" and the "will to be of service"—to be of service to our job, to our profession, to be of service to our nation, to be of service to the world! Several years ago Bob Russell, then head of research of the Esso Laboratories of the Standard Oil Company of New Jersey, was asked to deliver a lecture in Buenos Aires, Brazil, on "Catalytic Cracking Methods." He considered it a challenge to render service as an American engineer to the doubting Thomases in South America. He presented a complete technical lecture with a full discussion period in native Brazilian Portuguese. He had not known Portuguese previously, but achieved it because of his long years of self-discipline and his enthusiastic will to be of service. On short notice he commanded this ability to the mastery of technical Portuguese. Of greater significance—he learned the thinking process of the South Americans so that he could step into their minds and win their confidence in the integrity of his purpose. His personal satisfaction had many facets because of what he could "will" himself to do in service to others.

A few years ago I attended the ninetieth birthday celebration of Professor William Durand of Stanford University. He is responsible for many achievements, but perhaps his most famous work is on screw propellers, both marine and air. With extreme clarity of expression and depth of feeling he thanked his colleagues for the honors bestowed upon him, but his closing remarks were perhaps the most poignant: "The crowning happiness of my life, blessed as it has been by these ninety years, is the job of having been of service to my chosen profession." You must be a good soldier before you can be a general.

CONCLUSION

All measures of success are relative. Some achieve fame, others fortune, according to certain standards. But under the microscope of one's own peace of mind the measure of one's personal success is this: "What have I wrought in myself that will give satisfaction, will render service, and provide joy in living and in work?" That measure of success any man may attain, and without it no accomplishment is worth the having.

Under the strain of the world today and the personal problems you face in choosing a career, I am reminded of the story of Admiral Togo at Port Arthur in the Russo-Japanese War. For several days he was in a great dilemma as to the strategy he should use in attacking the Russian fleet. Finally he reached a decision and later gave expression to his experience in these words: "After a thousand guesses, then just one fixed purpose."

It is my firm belief that every man achieves the central theme of his life. Settle on a purpose and drive to that goal, whatever it is. You will be happy if you can learn to be of service.

ACKNOWLEDGMENT

The author is grateful to the following officials and their companies who supplied comments used in the paper: R. E. Peterson, manager, mechanics department, Westinghouse Research Laboratories, East Pittsburgh, Pa.; John Gammell, supervisor, sales training, general machinery division, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.; F. L. Meyer, president, The Meyer Furnace Company, Peoria, Ill.; W. W. Kimmell, industrial relations manager, R. G. Le Tourneau, Inc., Peoria, Ill.; W. C. Van Dyck, assistant manager, education and training department, Caterpillar Tractor Company, Peoria, Ill.; J. C. McKeon, manager, university relations, Westinghouse Electric Corporation, East Pittsburgh, Pa.; and K. B. McEachron, Jr., technical personnel services department, General Electric Company, Schenectady, N. Y.

European Nuclear Laboratory

ACCORDING to a recent issue of *UNESCO World Review*, 30 nuclear physicists from ten European nations met Oct. 4 to 7, 1952, in Amsterdam, Holland, and unanimously selected a site near Geneva, Switzerland, for a great European nuclear-research laboratory.

The laboratory, the article noted, is to house what may be the most powerful atom-smashing cosmotron in the world—a huge accelerator that will be rated at 30,000 million electron volts. There will also be a synchrocyclotron with a rating of 600 million electron volts.

It is reported that the laboratory will take about seven years to build and equip and will cost the participating countries an annual total of almost $4 million. It is to be used exclusively for pure scientific research. None of the results will be secret but will be supplied freely to all member-nations of the European Council for Atomic Research, an organization founded recently with the help of UNESCO.

A PLEDGE *of* FAITH *in* AMERICA'S FUTURE

Science and Technology in a Time of Challenge

By ALBERT C. JACOBS

CHANCELLOR, UNIVERSITY OF DENVER, DENVER, COLO.

THE source spring of America's strength in the present challenging world is to be found in our productive genius on the one hand and our individual freedom on the other. Far from being separated, the two are closely related. The engineer has a leading role in both this productive genius and in the maintenance of individual freedom. Much of the success of the engineering profession is the result of teamwork in creative purposes. The engineer has furthered the concept of individuals who see those creative purposes as essential in strengthening their free way of life.

Today, when survival as well as the progress of the free world are dependent upon continued technological and productive advances, the engineer is our most critical shortage—more critical than any material shortage. It is abundantly clear, moreover, that this is a shortage which will not eliminate itself in the crucial years ahead. The immediate problem then is how to keep production at a high and increasing level with undermanned engineering departments and how at the same time to eliminate that shortage.

GROWTH OF INDUSTRIAL POWER

We may well examine this critical situation from both a short- and long-range view. Historically, American production and American engineering—the two are inseparable—transformed this nation in the post Civil War years from an underdeveloped agrarian state into the world's foremost industrial power. This transformation is perhaps most graphically portrayed when we recall that in 1850, only slightly more than 5 per cent of America's industrial power was supplied by machines; 79 per cent of our power was then supplied by animals and about 15 per cent by human muscle. The need then for mechanical engineers was, in a sense, not great! More accurately, however, one might say that the need for mechanical engineers was, indeed, pressing, and the transformation which they have wrought has been amazing. Today, a century later, 84 per cent of our power is supplied by machines and only 12 per cent by animals and 4 per cent by man.

Today, as a cause and a consequence of our technological and industrial age, engineering is our third largest profession—exceeded only by teaching and nursing. Whereas in 1890, at a time when our land frontier had come to a close but our industrial frontier had only begun, the engineering profession numbered only 25,000; today it is 400,000. Yet there was never, aside from the war years, when measured in terms of the demands of the times, such a critical shortage as today.

TOO FEW ENGINEERS

It is abundantly clear that our technological advance, our prosperity and our strength in peace as in war are closely related to the engineering profession. The erratic growth of the need and the foggy realization of that need in this and other industrial nations are, however, another matter. Because the growth and need have not been understood clearly, we are in the present dilemma of a critical shortage. It is true that during the past century and more, as viewed in the over-all scope, there has been a constant and increased demand for engineers and engineering. Yet there have been many times when we erroneously thought we had too many engineers. Certainly this was our belief in the depression years of the 1930's. This was the case because we had lost our perspective, and had despairingly forsaken the fundamental truth that you cannot have prosperity without productive free enterprise and productive engineering. Only three years ago when there appeared evidence of a slight business recession, we again erroneously thought we had too many engineers. The mistake of that reasoning has been costly.

We realize by a study of history that the growth of engineering has been in response to urgent and pressing demands, and has resulted in the establishment of engineering schools to meet those demands. In France, for example, following the destructive devastation of the French Revolution, the Ecole Polytechnique was founded in 1795. Here in our own country, as we sought to tame the frontier, to build transportation and communication and industry as the nation expanded westward, the needs for engineering schools were evident. But it was the impact of the Civil War and the urgent demands that struggle made for engineers which produced the great growth of our engineering schools. In the midst of that War, in 1862, the Federal Land Grant Act was passed giving support from the income of public lands to engineering and agricultural colleges. Again, more recently, the first and especially the second world war, with the emphasis on mechanized warfare, underlined the engineering need. Today, it is Korea and the threat of communist aggression which have demonstrated again the shortage of engineers. After none of these wars has there been an excess of engineers. Indeed, the call of education has increased the shortage. Yet we have not realized this. It is ironic, indeed near tragic, that a peace-loving people with unparalleled productive capacity and opportunities apparently must have the stress of war-created national emergencies in order to realize their constant need for engineers!

I do not wish to be critical either of individuals or agencies as regards our past faulty forecasts of engineering needs. It is, however, significant to note that in 1946, a committee composed of representatives of the engineering schools working through the American Society for Engineering Education, of representatives of professional engineering societies, of the personnel officers of industrial corporations, of the United States Office of Education and the United States Bureau of Labor Statistics came to the solemn conclusion that by 1952 there would be no shortage of engineers. Actually, there is a

Address presented at the Regional Meeting of Region VIII, Denver, Colo., April 28, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Slightly abridged.

worse shortage today than in 1946, and the situation is daily getting worse instead of better. The United States Office of Education now predicts that by 1954 the number of engineering graduates will fall to 17,000, and the more pessimistic report by Dean Hollister of Cornell for the Engineering Manpower Commission of the Engineers' Joint Council, places the 1954 figure at 12,400.

In marked contrast no reasonable estimates place the annual need during the next several years below 30,000. Certainly, one can point to an emergency situation. And, make no mistake, an emergency situation will endure for many decades to come. The truth of the matter is that through the years our views as regards the need for engineers have been as clouded as were those of poor Joseph Addison writing in his famous *Spectator* in 1711, when he declared: "I am sometimes very much troubled when I reflect upon the three great professions of divinity, law, and physic (medicine); how they are each of them overburdened with practitioners, and filled with multitudes of ingenious gentlemen that starve one another."

AN EXPANDING TECHNOLOGY

How is it that a free people with a frontier heritage of an underdeveloped area can fail to see the need and the opportunity for technical and industrial development, not only at home but in the two thirds of the world's land which we refer to as underdeveloped? How is it that talks of a Korean armistice can bring in two days a two billion sell-off in stock-exchange values when a more stable and peaceful world actually means the opportunity for unprecedented industrial and technological growth? I submit that our thinking is not in keeping with our accomplishments, our opportunities, and our responsibilities. And when I speak of responsibilities and opportunities in underdeveloped areas of the globe, I am not speaking of government handouts. I refer rather to sound business investment in technological and industrial advance in areas whose products we need and which welcome such investments. At the same time this investment would be the free world's answer in those critical areas to the challenge of communism.

Furthermore, these United States are of themselves a land of continuing and expanding opportunity. There were those who said in 1929, or certainly in the debacle which followed, that the peak of our industrial and technological expansion had been reached. Yet we know in retrospect that the 1929 rate of industrial activity would tremendously lower our current living standards. Yes, today United States industry, with the help of the engineering profession, is getting bigger and bigger. For example, in 1951, the capital expenditures in the oil industry increased 42 per cent above the 1950 figure, and the increase in the steel industry was 134 per cent.

The position of the engineer in the local, national, and international community is of such prime importance that together with his engineering training he should receive a broad and a liberal education. The engineer today and the engineering teacher need a thorough acquaintance with the problems of society, with the fields of pure and social science—indeed, there is no entirely separated area of applied science. The engineer must have a full view of civilization and the impact of technology upon civilization. He must clearly identify true principles of individual freedom and realize his full share of responsibility in furthering the American way of life, synonymous with individual opportunity, which he has done so much to create.

I well recall one of the last statements which my long-time colleague, James Kip Finch, made as Dean of the School of Engineering at Columbia: "There is," he declared, "a general feeling among those interested in educational problems that developments are impending, are, in fact, already under way which will vitally affect the future of engineering education. Yet there seems to be little general understanding as to what such changes imply or where they are leading us. There is, in short," he concluded, "a sense of movement which is essentially disturbing to the engineering mind for we apparently lack a clear notion as to its direction or destination." Ours is the challenge to advance the frontiers of engineering science and to continue the development of a way of life insuring the individual freedom and the economic, social, and political stability of which technological advance is an integral part.

INDUSTRY ATTEMPTS TO RELIEVE SHORTAGE OF ENGINEERS

Today American corporations faced by the engineer shortage are making every possible effort to relieve that shortage. There are some things which can be done and are being done. First, of course, every effort must be made for the most efficient use of available engineering personnel by taking them off jobs that call for semi-skilled or skilled personnel but not professional engineers. Then there are the possibilities of recruitment. Today industry is seeking to interest both the teachers and students in high schools in the engineering profession. Perhaps this recruitment on the collegiate level was most dramatically portrayed recently when the United States Steel Corporation in a nationwide broadcast invited Dean John Dunning of Columbia to speak on the subject of the pressing need for more engineering students. Another hopeful program received encouragement through the ROTC units in our colleges and universities.

But none of the measures can of themselves or together relieve the shortage of engineers. Only when we have a clear understanding of the constant needs for the engineer in our civilization, of his vital importance, will we have solved this pressing issue. To work toward this end is our responsibility, the worthy task of engineering and education. Ours should be a joint pledge of faith in America's future.

Do we grasp the full significance and responsibility placed upon those in engineering and engineering education? As one in the latter category I have long been intrigued by the enigmas and paradoxes of this so-called scientific and mechanical and technological age. Scientists and engineers working as a team have made possible the hundreds of electrical and mechanical devices which we accept as a part of our daily lives. Yet I would wager that not one person in ten thousand, including myself, has a clear understanding of such of those devices as the telephone or the radio, to say nothing of television, which we either take for granted or consider as pure magic. Such being the case, we may well re-examine whether we truly live our daily lives in a scientific and a technological world. There are many apparent physical manifestations of such an age, but the thinking in it is hardly coupled with these gadget-like manifestations—even in the home of the engineer and the scientist! I am not saying that we should become mechanical robots in our thinking processes. Heaven forbid that we should seek to devoid ourselves of feeling and emotion whence come some of the finest inspirations and creations! I am, however, suggesting that in this atomic age our thinking has not kept pace with this mechanistic advance.

These foregoing facts are rather self-evident, and yet I do not believe that the conclusions which follow are always entirely valid. I refer most particularly to those of the so-called "social engineer" to whose thinking, I trust, the mechanical engineer has not yet succumbed. He is certainly not the product of our engineering schools, but rather of the doubtless well-meaning but soft-thinking social scientist. Out of many of our universities he has brought such new dictionary terms as "communication engineering" and "group dynamics." The disciples of such fuzzy thinking—and the numbers of them are

rapidly multiplying—are coming to agree with Alfred Morrow, who seriously asserts: "Experiments on social relations can be controlled much as are experiments in physics and chemistry. . . . The resulting body of knowledge," he concludes, "can be depended upon and referred to like the chemist's tables of valences or the engineer's equations for stress."

Now I may be just "old-fashioned," but I simply cannot go along with this line of reasoning, which, it seems to me, has as its ends a planned social and economic life and the elimination of individual freedom. Further, I hope that those trained in mathematics, physical science, and other components of engineering are inclined to agree that the transfer of predictability is not entirely as valid in human relations as in building materials! I am still inclined to agree with the late James Rowland Angell "that in phenomena as complex as those with which these social sciences for the most part deal, the simple, severe, cause and effect conception is often bankrupt before it begins to function. In these ranges, even more obviously than in biology, one is dealing with circumstances much more nearly analogous to the space-time configurations of the macroscopic mathematical physics, where single causes can be dealt with in isolation, only as a matter of sheer intellectual abstraction."

I hasten to add that I do not seek the delimitation of science and engineering to the physical world outside of human relations. Far from it! Industry, agriculture, business and government, and the social scientist, too, do gain much from the methods of the scientist and the engineer. Yet until we have approached a far greater perfectibility of human behavior, this scientific mechanistic approach to human behavior and to its control must be beset by pitfalls.

HOPE FOR THE FUTURE LIES IN EDUCATION

What then is the principal hope for the world's political, social, and economic ills? My answer may sound disappointing, yet I do believe it realistic. The answer can only be found in education itself. Science and technology are inherent parts of our civilization and must be inherent parts of education. Through education a clearer grasp will be had of their part in our culture ranging from that afore-mentioned radio and television set to the implications of television and atomic energy on society. Education must be a continuing process. That is why we place such stress upon adult education.

From the methods of the scientist and the engineer, education should seek to inculcate clear thinking and careful analysis of issues and problems. We may well hold in mind the truth which the late William Barclay Parsons pronounced just twenty-five years ago to a young group of engineering students: "It is not the technical excellence of an engineering design which alone determines its merits but rather the completeness with which it meets the economic and social needs of its day." Ours is the continuous challenge of preserving and strengthening the faces of freedom.

"Civilization," as Gilbert Murray reminds us in *The Ordeal of This Generation*, "is, ultimately, the process whereby a human society in search, as Aristotle puts it, of 'a good life for man,' gradually overcomes the obstacles, material and other, that stand in its way and makes man increasingly master of his environment." To accomplish this end we should and must seek that rare combination of science and humanity, ever holding in mind the essential dignity of the individual in spite of his imperfections, and that he must be aided but not enchained by the technological age in which he lives. Let this be the pledge of faith of our professions of education and engineering as we work together toward the noble purpose of civilization's progress and the freedom and enlightenment of mankind.

Bringing the Engineering Viewpoint to Bear on Public Affairs

(Continued from page 968)

functional managers. A growing number of these are mature engineers. I should point out here, however, that a large number of men are also very successful in these jobs without engineering training at all, indicating that other characteristics are needed, and frequently sufficient. Most large industries are now engaged in a serious study of how such men may be selected and trained for these jobs. Governments should do likewise.

Perhaps the great educational institutions need to study these requirements, and develop courses of training which will lead to professional management of not only private business, but public business as well—which will produce men trained in the business and government needs of today as the lawyer was trained in those of yesterday. We will find many young men potentially qualified for this work who are not qualified to become highly successful technical engineers. We then need to find ways of introducing them into industry and government. We have found ways of introducing the technical engineer, but less so the man with management training.

It will then be necessary to train the high-school vocational-guidance people to select suitable young men, and perhaps women, and encourage and guide them into this training which will make them suitable for these important fields of activity.

Perhaps to meet the urgent needs of today, these courses need to be developed and put out as extension courses for on-the-job taining of men in place in government today. This great university has done this so well in other fields of training, and could do it here. There are many well-informed men in industry who feel that this on-the-job training of mature men in these management jobs is much more effective than carrying out such training at the college age.

Then we, as citizens, will have the obligation to see that such trained men can be put in positions to manage our public affairs, and that they are then paid enough to permit them to stay in such service, despite the competitive demands for their services elsewhere. Adequate compensation for competent managers of our public affairs will be an economy.

Under such conditions, I doubt if the question of corruption in government would present more than a fraction of the problems it now seems to impose.

To summarize—I believe we need the practical, informed, and so intellectually honest approach to public affairs that the engineer has brought to our private industrial affairs. This cannot in my judgment be obtained by the part-time attention of engineers on a layman basis in government, but must be obtained by professionally trained public administrators who will need much, but not all, of the technical training of the engineer, supplemented by the broader training required of this field of administrative work.

Even if we do this, as you may recognize and object, we may not solve all of the pressing questions of high policy. Those I have not been talking about. As to these great questions of high policy in this democracy, we all have the obligation to do the best we can, and pray God that our imperfect democratic processes may lead us to a man and to men with the wisdom, inspiration, and guidance to take the right roads in the labyrinth that lies ahead of us.

However, I am convinced that if we can learn how to train and put in position men to do the details which I have been talking about correctly, it will then be easier to solve our bigger problems in that framework.

WOODWORKING MACHINERY

History of Development from 1852–1952

By JUDSON H. MANSFIELD

CHIEF ENGINEER, GREENLEE BROS. AND COMPANY, ROCKFORD, ILL. MEMBER ASME

FOUR PIONEER MACHINE MAKERS WHO ARE STILL ACTIVE

THREE companies, organized before 1852, and a fourth founded in 1854, are still manufacturing woodworking machinery. The H. B. Smith Company of Smithville, N. J., was founded by H. B. Smith who built his first woodworking machine in 1832 for use in his cabinet-making shop because the machinery manufacturers would not build what he wanted. These machines were found to be superior to those on the market and led to his forming the H. B. Smith Company, specializing in building woodworking machines with iron frames or bases cast in one piece. The company has been operated continuously by members of the Smith family. At present its president is Mr. Earl J. Smith. Part of the data used in compiling this paper are taken from a bound volume of the *New Jersey Mechanic*, a house organ published by them in 1870 and 1871.

Baxter D. Whitney & Sons, Inc., of Winchendon, Mass., was founded in 1837 by Baxter D. Whitney. Mr. Whitney's father owned and operated a woolen mill. Young Baxter's first business venture was in the repair shop of the mill building machinery for manufacturers of wooden tubs and pails. In 1837 he built sixteen looms for weaving cashmere, but apparently the machines for tub, pail, and chair manufacture attracted him to the woodworking-machinery business. Fig. 1 shows his first cylinder planing machine. Mr. William

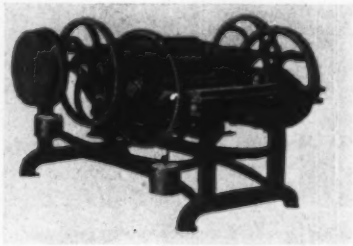


FIG. 1 FIRST WHITNEY CYLINDER PLANER, 1846–1866

M. Whitney, a direct descendant of the original Baxter D. Whitney, is now president of that company.

In 1893 the J. A. Fay & Company, founded in 1841, combined with the Egan Company, organized in 1874, to form the present J. A. Fay & Egan Company of Cincinnati, Ohio. The J. A. Fay & Company operated several plants, and while it has been in continuous operation, the management has not remained in one family group as has the H. B. Smith and Baxter D. Whitney companies.

The S. A. Woods Machine Company of Boston, Mass., founded in 1854, has continuously manufactured a line of

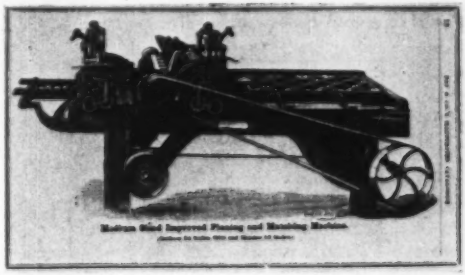


FIG. 2 PLANING AND MATCHING MACHINE, 1860
(Courtesy Fay & Egan.)

planers, matchers, flooring machines, and molders, later adding a variety of circular saws, band resaws, saw-filing and gumming machines, tenoners, chain mortisers, and automatic variety lathes.

WOODWORKING MACHINES OF 1860

An 1860 catalog of the J. A. Fay & Company illustrates 73 woodworking machines, 6 metalworking machines, 6 portable steam plants, 8 stationary steam engines, noiseless fan blowers, grist mills, and rubber and leather belting.

Fifty of the 73 woodworking machines used frames built up of hardwood with metal brackets and the remaining 23 were of cast iron. Those listed are as follows:

Planing and matching machines, Fig. 2, cylinder planers, Daniels planers, molding machines in several sizes, tenoners, blind slot tenoners, power mortisers, scroll saws, vertical single-blade resaws, Fig. 3, circular resaws, saw tables, railway cutoff saws, boring machines, multiple-spindle routing and boring machines, spoke-forming lathe, dowel machines, turning lathes, molding and shaping machines, and saw arbors.

These early machines had either built-up wood frames with cast brackets, bearing yokes, and so on, single-piece cast frames or several cast-iron pieces fastened together by screws or bolts. All bearings were either of babbitt metal cast around arbors in the bearing housings, or holes bored and reamed in the casting which were sometimes brass-bushed for higher speeds, but frequently the shaft ran directly in the reamed hole.

Cutter spindles and rotating parts were driven by flat belts, limiting both the speed and power available. Heavy surfacers and matchers usually were driven by pulleys mounted at both ends of the cutterhead arbors. Gears and racks had cast teeth which were smoothed by hand with a file or formed grinding wheels. Bearings were lubricated by wicks or oil reservoirs filled with wool waste. Designs of many of these machines were worked out in the pattern shop without the aid of drawings other than a general layout. Patternmakers in those days were a combination of machine designer and pattern maker.

These early machines went into mills, mostly powered by

Contributed by the Wood Industries Division and presented at the Fall Meeting, Chicago, Ill., September 8–11, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

water wheels, belted or geared to line shafts, which transmitted the power throughout the plant. The individual machines were driven from these line shafts by tight and loose pulley countershafts, either built as part of the machine, or located on the floor or ceiling close by. One mill, in its advertising, stressed the point that it had available 370 hp generated by a water wheel.

The gearing used in connecting the water wheels to line shafting consisted frequently of a cast bevel gear running with a mortised-type gear, in which hickory or maple teeth were inserted in pockets cast in the rim of the wheel, the teeth being formed to proper shape by hand. The men who kept these wheels in repair were about "tops" among the mechanics of that day and their prestige was considerable.

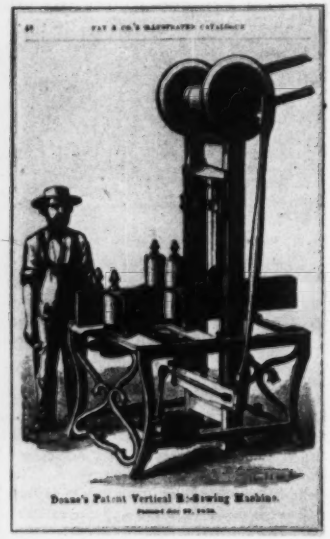


FIG. 3 DOANE'S VERTICAL-BAND RESAWING MACHINE, 1860
(Courtesy Fay & Egan.)

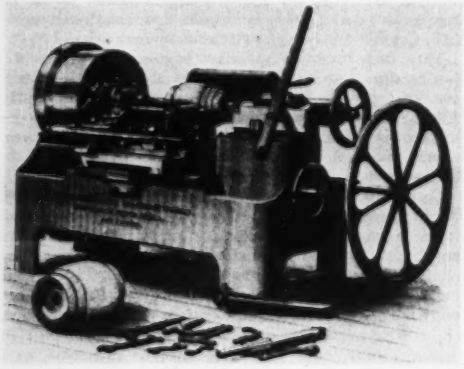


FIG. 4 AUTOMATIC HUB-TURNING MACHINE, 1904
(Courtesy Defiance.)

WAGONS FOR THE OVERLAND TRAIL

The discovery of gold in 1849 in California and the westward movement of settlers created an enormous demand for covered wagons, carriages, and carts, which was further stimulated by the Civil War. This demand far exceeded the capacity of the local wagon builders and blacksmiths, and many

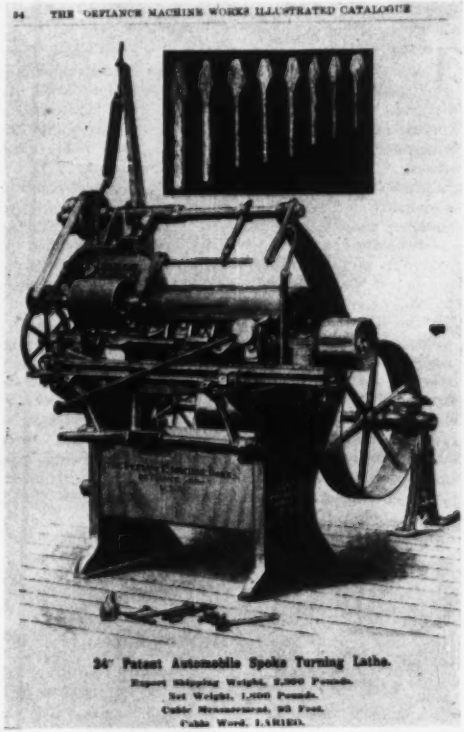


FIG. 5 AUTOMATIC SPOKE-TURNING LATHE, CIRCA 1904
(Courtesy Defiance.)

new factories were started. Certain sections of the country built up a reputation for types of wagons such as the "Conestoga" covered wagon of western prairie fame, and one writer claims that our present slang name of "stogie" for cigars had its birth in one of these communities. The wagonmakers there smoked strong black cigars and, because they worked on Conestoga wagons, were frequently called "stogies," and the name has clung to this particular type of cigar for nearly a century.

The Studebaker Corporation of South Bend, Ind., celebrates its centennial this year. It was eight years, or 1860, before that company became a manufacturer and stocked its wagons and carriages, which previously had been built to order only, partly because of lack of capital for the purchase of machinery.

During this peak demand for vehicles, machines were developed for special operations for the various units making up

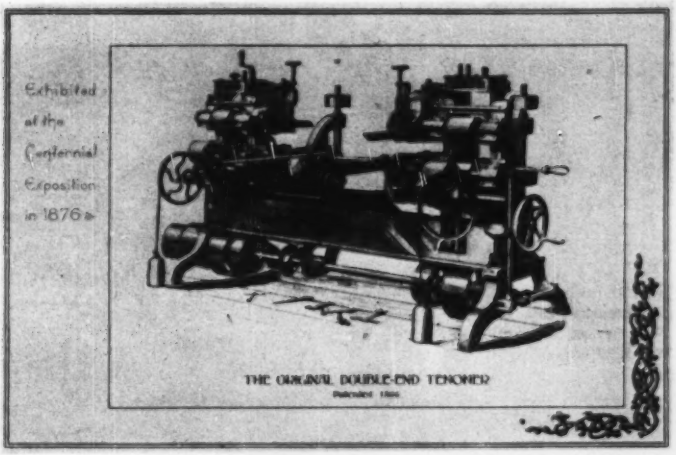
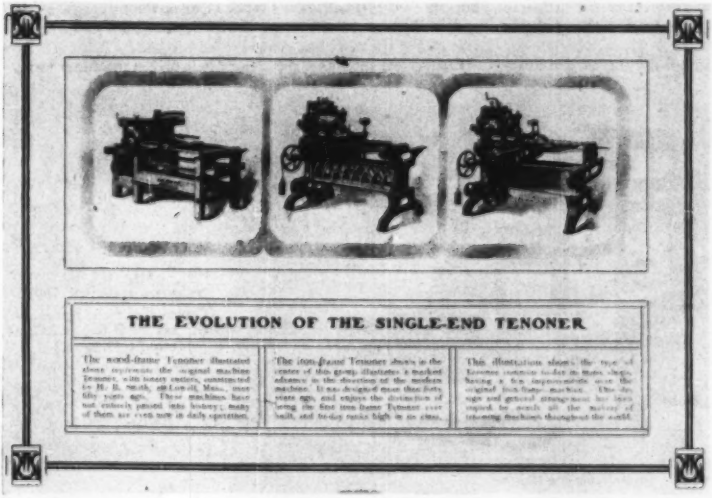


FIG. 7 ORIGINAL DOUBLE-END TENONER
(Patented 1866; exhibited at Centennial, 1876. Courtesy H. B. Smith.)

the wagons such as wheels, axles, reaches, neck yokes, and eveners. Ingenious machines were built for operations such as boring, turning, and mortising the hubs; turning, tenoning, and shaving spokes; also for truing and finishing up the wheel assemblies. Other machines were felloe-bending, boring, planing, sawing, and sanding machines. Fig. 4 shows an automatic hub-turning machine. An automatic double-spoke tenoning, mitering, and pointing machine, Fig. 5, is another typical example.

Other manufacturers were bringing out machines suitable for the sash and door and furniture trade. The first single-end tenoners were marketed about 1850, and were wood-frame machines with arbor-bearing yokes, slides, brackets, and table-wheel rails of cast iron, Fig. 6(*a*). The machine proved very valuable and was soon replaced by machines which were entirely of metal, Fig. 6(*b*). By 1866, the original double-end

FIG. 8 SILVER MEDAL PLANER, 1866–1878
(Named from 1867 Paris award. Courtesy Baxter D. Whitney.)



(*a*) Single figure at *left*; (*b*) two figures at *right*

FIG. 6 EVOLUTION OF SINGLE-END TENONER, BEFORE 1902
(From wood frame to fancy and sturdy metal frame. Courtesy H. B. Smith.)

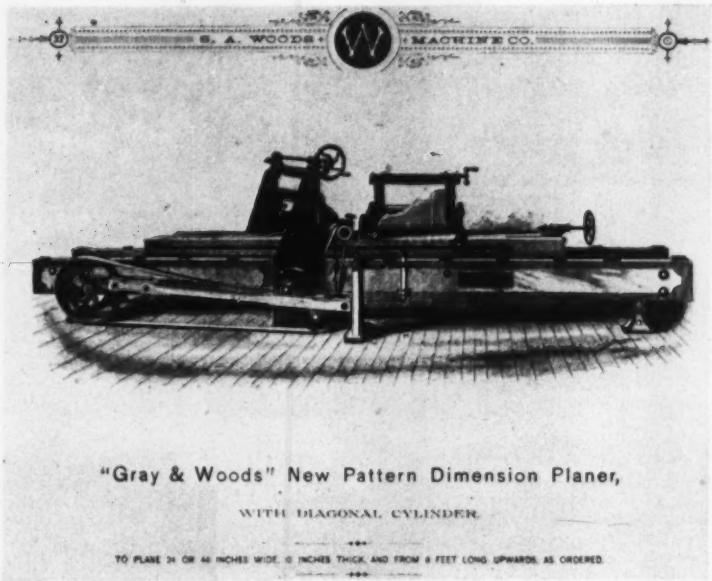

S. A. WOODS MACHINE CO.
"Gray & Woods" New Pattern Dimension Planer,
WITH DIAGONAL CYLINDER.
TO PLANE 24 OR 46 INCHES WIDE, 12 INCHES THICK, AND FROM 6 FEET LONG UPWARDS, AS ORDERED.

FIG. 10 GRAY & WOODS PLANER, 1884
(With diagonal cutting cylinder. Courtesy S. A. Woods.)

tenoner, shown in Fig. 7, was patented and exhibited at the Centennial Exposition of 1876.

FIRST CYLINDER PLANER IN 1860

Baxter D. Whitney built the first practical cylinder planing machine before 1850, and in 1866 introduced a new type, displayed at the 1867 Paris Exposition, where it received a silver medal and became known as the "Silver Medal Planer," Fig. 8. This supplanted the company's first planer, Fig. 1. Designed into this Silver Medal Planer were such features as the upper and lower wedges for support and adjustment of the bed, still standard in all heavy planers now in production, thus proving the soundness of the original design.

These cylinder planing machines replaced the earlier fixed-knife roll-feed machines and the Daniels planer, Fig. 9. The fixed-knife planer was like a large hand plane except for the addition of power-driven feed rolls moving the work past a stationary knife or bit.

On an improved Daniels planer, Fig. 10, the cylinder cutterhead was set at an angle producing a shear cut eliminating to some extent tearing of cross-grained wood. The roll-outfeed return is shown swung out of the way of the platen to which are dogged the planks to be surfaced. Fig. 11 shows an early endless-bed double-surfacer patented July 19, 1881. A top and bottom feed roll carries the stock clear of the machine, as the endless bed stops just ahead of the bottom cutterhead at the rear end of the machine.

Cutterhead speeds on these early belt-driven machines ran at

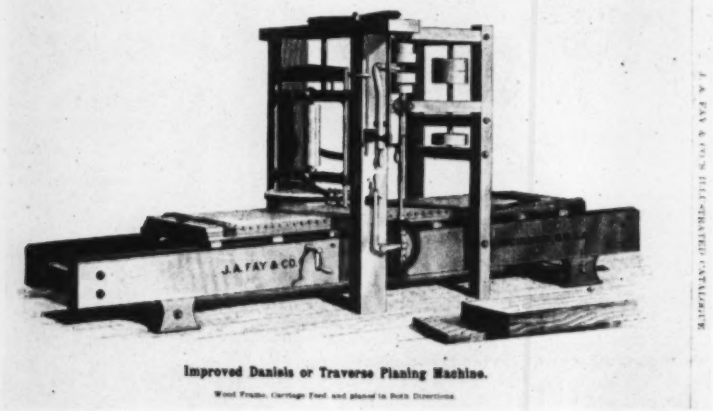

J.A. FAY & CO.
Improved Daniels or Traverse Planing Machine.
Wood Frame, Carriage Feed and planed in Both Directions
J. A. FAY & CO'S ILLUSTRATED CATALOGUE

FIG. 9 DANIELS TRAVERSE PLANING MACHINE, 1893
(Copied after metal planer design; has wood frames. Courtesy Fay & Egan.)

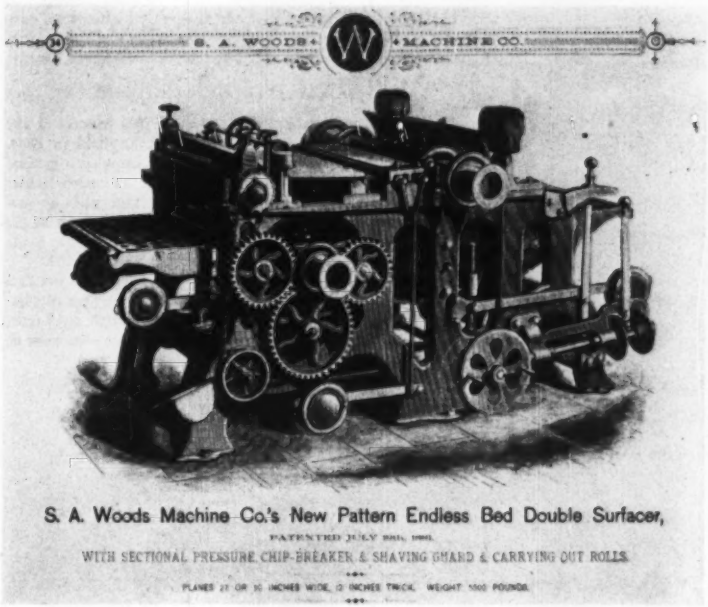

S. A. WOODS
MACHINE CO.
S. A. Woods Machine Co.'s New Pattern Endless Bed Double Surfacer,
WITH SECTIONAL PRESSURE CHIP-BREAKER & SHAVING GUARD & CARRYING OUT ROLLS.

FIG. 11 ENDLESS-BED DOUBLE SURFACER, 1884
(Courtesy S. A. Woods.)

about 4000 rpm which was the maximum that could be obtained with belt drives. Spindle pulleys had to be held to about $4^1/_2$ to 5 in. so that the centrifugal force of the belt around the pulley would not significantly reduce the grip between the belt and pulley.

HOLLOW CHISEL MORTISER ABOUT 1870

In 1866, identical-twin brothers, Robert and Ralph Greenlee, formed the Greenlee Brothers & Company in Chicago. William B. Greenlee, son of one of the original founders, is at present chairman of the board of the plant which was moved from Chicago to Rockford, Ill., in 1903 and 1904.

One of their early inventions was the hollow chisel mortiser, Fig. 12, exhibited at the Centennial Exposition in 1876 where it created interest second only to the famous Corliss engine. Other early machines developed by the brothers were spur-feed self-feed ripsaws, sash and blind relishing and mortising machine, sash and door clamp, and railway carshop machinery.

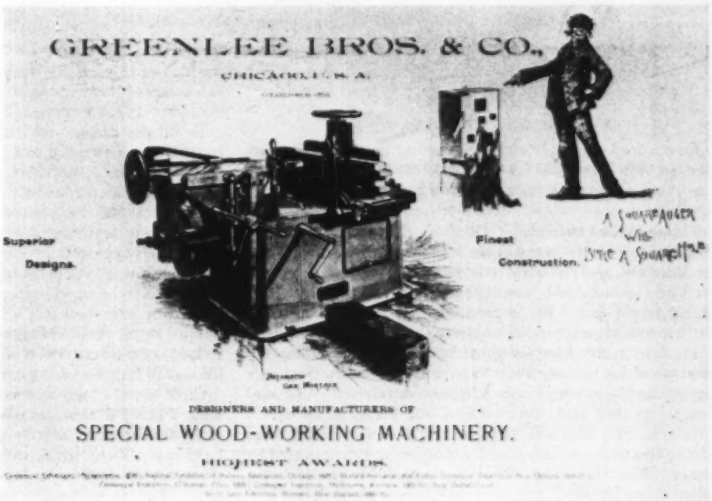


FIG. 12 HOLLOW CHISEL MORTISER, 1870–1876
(Courtesy Greenlee Bros.)

PIT SAW EVOLVES INTO GANG SAW

The earliest log saw on record is the pit or drag saw. A recent travelogue of Central Africa showed two natives sawing a log by this method.

The blade is of such length as to accommodate two men, the log being located over a pit. One man, the top sawyer who is "boss man," stands on top of the log and guides the saw while his assistant, the pit man, is beneath the log and helps run the blade up and down, cutting the boards off at a rate of 100 to 200 ft per day. The expression "top sawyer," meaning the best man or boss, was derived from this pair of workers.

FIG. 13 DOANE'S CIRCULAR RESAWING MACHINE, 1860
(Courtesy Fay & Egan.)

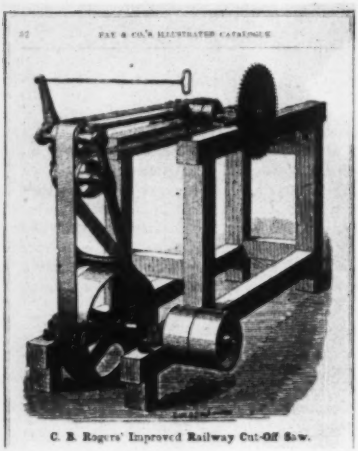


FIG. 14 ROGERS' RAILWAY CUTOFF SAW, 1860
(With wood frame. Courtesy Fay & Egan.)

The first recorded improvement in this type of saw was the addition of a stiffening frame, with members passing on each side of the log in which a thin blade was fastened under tension. The thin blade cut less kerf and pulled much easier. This type of frame was soon provided with vertical ways sliding up and down on stationary uprights and reciprocated by power. The log or board was advanced by power-driven rolls, or a ratchet feed, eliminating the heavy physical work.

The modern design of this old saw, in which several saw blades are mounted, provides one of the fastest and least wasteful methods of converting small and medium logs into lumber.

CIRCULAR SAWS IN GENERAL USE BY 1860

The first indication of circular saws in this country is the importation of a rather large blade from England in 1814, for use in a log mill. These circular saws came into general use between then and 1860. Fig. 13 shows an early circular roll-feed resaw, and Fig. 14 a hand-feed large railway saw for cutting large timbers and wide built-up units such as car doors. Band saws were in use but with considerable blade breakage until those of Swedish steel were available in 1870.

Rapid expansion of railroads and the completion of the first transcontinental road in 1869 required a large number of cars. These cars were largely constructed of wood with steel truss rods in the underframe. Many of the workmen who went to the harvest fields of the West rode these rods under freight cars as a means of cheap transportation, and the expression "hitting the rods" is a slang phrase of many years' standing.

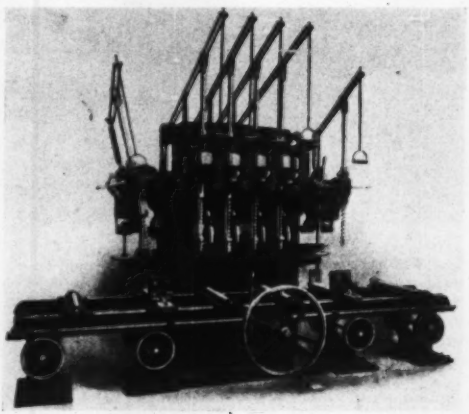


FIG. 15 NO. 336 STANDARD COMBINED VERTICAL AND RADIAL MULTIHEAD CAR BORER
(Courtesy Greenlee Bros.)

To fill the demand for car parts, heavy machines of large capacity were designed, consisting of multiple-spindle boring machines, gainers, mortisers, tenoners, and saws.

The multiple-spindle borer, Fig. 15, was built with three or four vertical and one or two adjustable spindles which could be set at any angle up to 45 deg, either side of vertical. All spindles adjusted in and out over the work table. The number of spindles was largely determined by the number of different-sized holes to be bored in the average work. These holes were located by templates laid on each work face with projecting pointed metal pins. A hammer blow on each pin marked the location of the hole, and it was up to the operator to remember the size of hole for each location.

Often a car borer, mortiser, and gainer, Fig. 16, were set up as a group to operate on one table so that all operations on each member of a car-body frame could be completed in one handling. These tables were power-driven and fitted with stops, which could be set lengthwise of the table, for the location of various mortises, tenons, and holes.

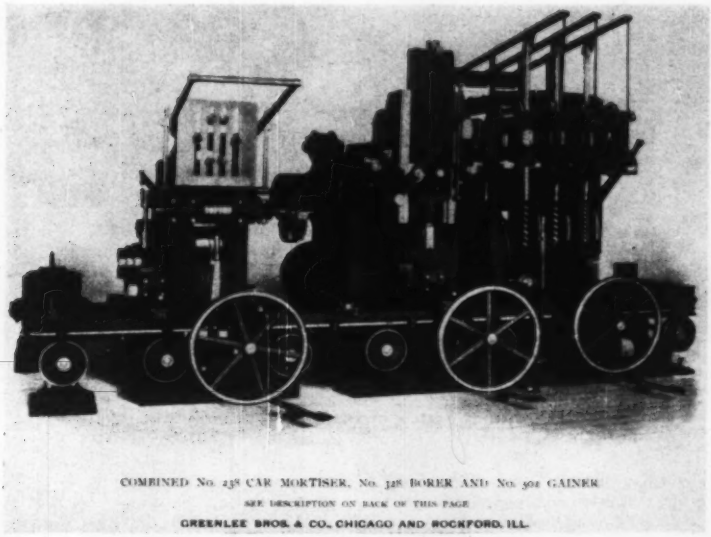

COMBINED No. 238 CAR MORTISER, No. 328 BORER AND No. 502 GAINER
SEE DESCRIPTION ON BACK OF THIS PAGE
GREENLEE BROS. & CO., CHICAGO AND ROCKFORD, ILL.

FIG. 16 COMBINED MORTISER, BORER, AND GAINER
(Courtesy Greenlee Bros.)

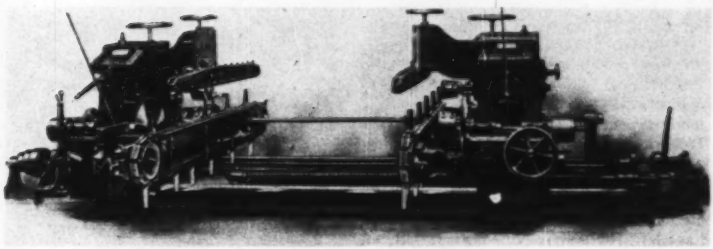


FIG. 17 HEAVY-DUTY DOUBLE-END TENONER
(Belt-driven. Courtesy Greenlee Bros.)

The heavy double-end tenoner, Fig. 17, was developed and built for car work with a capacity of 12-in. × 12-in. timbers 12 ft long. This tenoner is the largest-capacity machine ever built, and, of course, was belt-driven from a tight and loose pulley countershaft. Since heavy timbers are no longer used in the frame construction of cars, this machine has been off the market for many years.

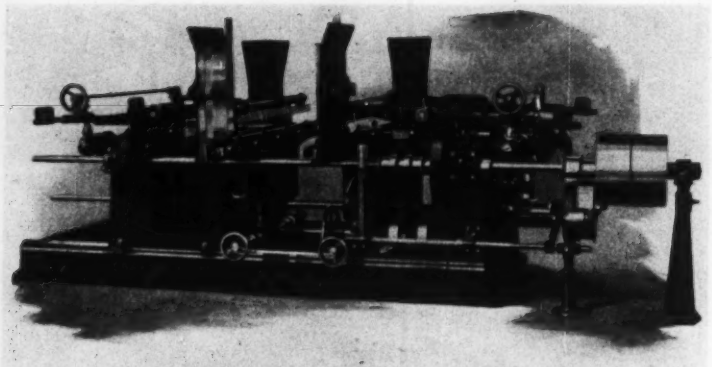
SASH AND DOOR TECHNIQUES

In sash and door plants the replacement of mortised and tenoned doors by those assembled with dowel pins created a demand for special machinery developed for this construction. The "three and one" rail borer, gluer, and dowel drive, Fig. 18, with hopper feed, saves material and eliminates two handlings of the work. Stile borers, panel raisers, clamps, sanders, and self-feed ripsaws increased over-all plant efficiency.

Self-feed ripsaws, feeding 400 fpm, are set in gangs to cut out the planks to the widths used for various sash and door parts. Rollers are incorporated in the machine for returning the board to the feeding end of the machine for subsequent cuts, and for delivering the dimensioned pieces to conveyers. From the ripsaws, these long strips are conveyed to the cutoff department where they are cut to required lengths after removing knots and other defects. The short pieces of waste are conveyed to a department where cores for door stiles are assembled from pieces as small as 1 in. × $1\frac{1}{4}$ in. × 6 in. These are glued up between full-length strips $\frac{3}{16}$ in. thick. This method of manufacture is economical and uses a lower-grade material without affecting the quality of the finished part. This technique has been brought to its present state of perfection, largely, by plants located in the Mississippi River Valley.

BAND SAWS DISPLACE CIRCULAR SAWS FOR ENORMOUS WEST COAST LOGS ABOUT 1880

The stands of fir and pine timber in the Pacific Northwest, where logs of up to 6 and 8 ft diam are not unusual, required



No. 126 Combination Boring, Gluing and Dowel Driving Machine

FIG. 18 COMBINED BORING, GLUING, AND DOWEL-DRIVING MACHINE
(Courtesy Jenkins.)

the development of large sawmills. One of the mills in Washington has a foot-long slice off the top of the stump of a fir tree which is about 12 ft, 9 in. in diam and had 586 annual rings at the point of cut, showing it was a seedling in 1320. There are two large firs still growing which are to be left until they reach a natural death or are accidentally destroyed by lightning or fire. Both of these firs are now over 10 ft in diam.

Double circular sawmills, Fig. 19, were developed to handle these large logs. Mills with 72-in lower and 36-in upper blades are about the largest built and would remove a substantial kerf, as the saw blades had to be thick enough to make a heavy cut without vibration.

The need of a more efficient and less wasteful method was apparent and, in 1869, the first large log band mill was built. This was still running in 1923. Allis-Chalmers Manufacturing Company of Milwaukee brought out its first large band mill, Fig. 20, in 1885, which had 9-ft-diam by 8-in. face wheels, the upper one being built of wood for lightness. Four years later mills with 8 and 9-ft wheels were being made entirely of iron. In 1896 Allis-Chalmers' first electric-driven mill was set up including a 9-ft band mill running a 14-in-wide saw which was driven through gears by a 100-hp electric motor. Sawmill carriages with rope or direct steam feeds, Fig. 21, set works, edgers, slashers, Fig. 22, cutoff saws, steam-feed jump saws, and complete log and lumber-conveying systems were developed for mills handling as much as 150,000 ft per day.

Fig. 23 shows a mill containing one band mill with 11-ft-diam wheels and two with 9-ft wheels.

The efficiency and quality of work produced by either the circular or band mills depended on the skill and knowledge of the plant "saw filer." The term saw filer is probably a misnomer, as most of these saws are and were sharpened on special grinding machines and not filed at all. The tracking and smooth running of the blades are accomplished through proper tensioning by either hammering or rolling. These so-called saw filers, usually one or two in a plant, were very important men. The service of those with good reputations was often obtained by outbidding the company in whose employ they had been.

The author was named after one of these saw filers who worked in the mills on the Mississippi Valley near Clinton, Iowa, in the last half of the nineteenth century.

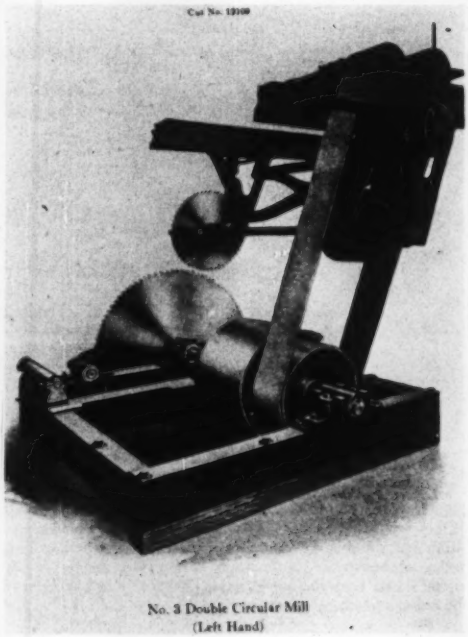


FIG. 19 DOUBLE CIRCULAR MILL FOR SAW LOGS, CIRCA 1870
(Courtesy Allis-Chalmers.)

QUALITY CONTROL WITH CUTTERHEADS

Quality of finish of the surface of lumber produced by surfacers, molders, matchers, and machines, using cylindrical

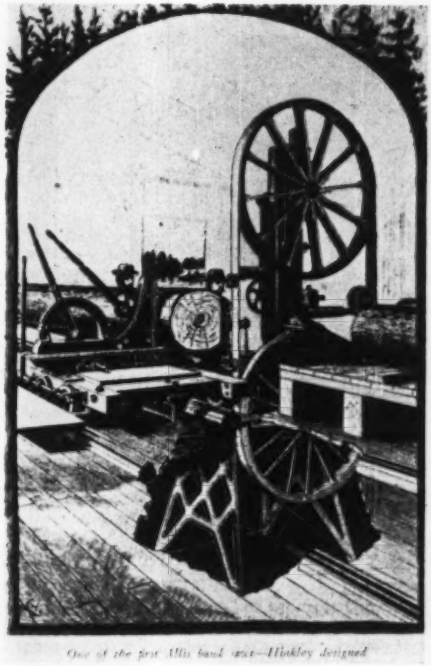


FIG. 20 EARLY BAND MILL, 1885
(Designed by Hinckley. Courtesy Allis-Chalmers.)

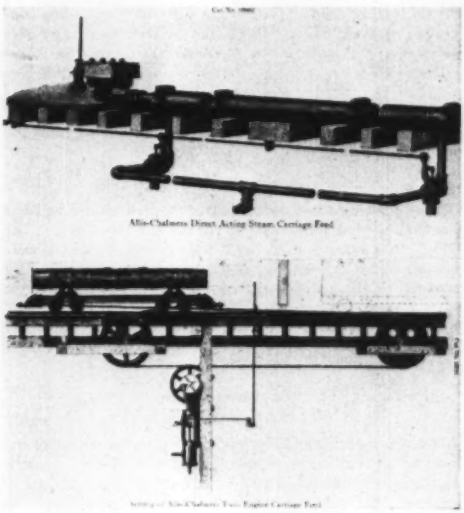


FIG. 21 LOG CARRIAGE FEEDS
(Direct steam drive and twin-engine drive. Courtesy Allis-Chalmers.)

FIG. 22 OVERHEAD TRIMMERS WITH 31 CUTOFF SAWS, CIRCA 1896
(Courtesy Allis-Chalmers.)

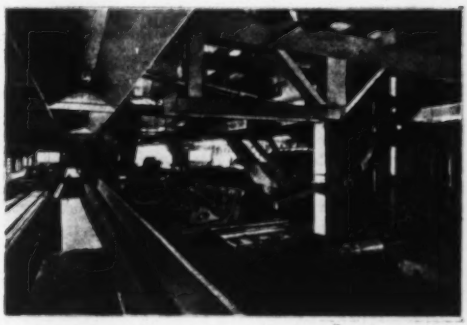


FIG. 23 SAWMILL OF THE CANADIAN WESTERN LUMBER COMPANY, FRAZER MILLS, B. C., CONTAINING ONE 11-FT AND TWO 9-FT ALLIS TYPE B BAND MILLS; BOTH MILLS ARE DOUBLE-CUTTING
(Courtesy Allis-Chalmers.)

heads, is controlled by a number of factors. The type and diameter of cutterhead, speeds, knife cuts per inch, cutting angle, and amount of joint on the knives are all important.

About 1900, experiments in grinding and jointing of knives, mounted in the cutterheads while in the machine, were tried out and proved superior to the previous method of grinding the detached knives and clamping them in the heads as accurately as possible. The improvement in the quality of work was so great that the grinding and jointing method was adopted and is still standard practice. The surfacer, Fig. 24, has a built-in grinder bar and slide, to which a motor-driven grinder is mounted, for sharpening the knives. Following the grinding, the motor is replaced by a jointing stone. The cutterhead is run at its rated speed, and the knives are jointed by drawing the jointing stone, back and forth, over the full length of the knives. The stone is adjusted to remove a very small amount of metal from each knife, but to bring all cutting edges into a true circle.

Jointing gives assurance that each knife, regardless of the number, will perform its share of shaving removal, producing a well-finished and relatively smooth surface with uniform depth and width for all knife marks. This, of course, is only true when the head bearings are snug and in good shape. Jointing knives opened up a new approach to good workmanship and

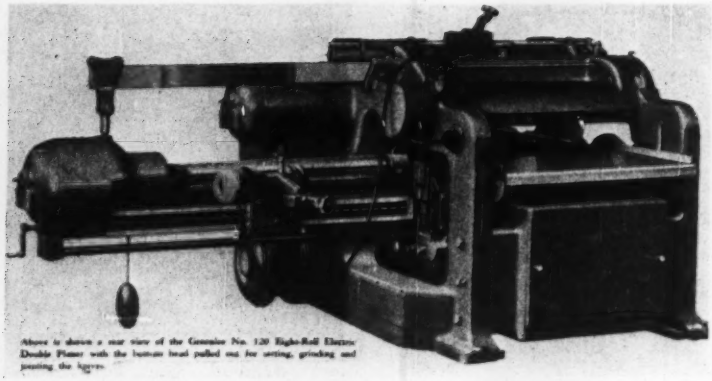


FIG. 24 EIGHT-ROLL DOUBLE PLANER
(Lower head pulled out for setting, grinding, and jointing. Courtesy Greenlee Bros.)

greater output. Increased feeds could be obtained by increasing the number of knives in heads, and machines were built and operated with as many as 20 knives mounted in heads on an 11-in. cutting circle. However, most of the machines now use heads with 4, 6, or 8 knives.

FREIGHT CARS TURN TO STEEL ABOUT 1901

New methods of manufacturing steel increased the output and reduced the cost of this material to a point where it replaced wood for structural purposes. In 1897 no freight cars were built of steel. Of 137,000 freight cars built for freight service in 1901, 20,000 were either all steel or had steel structure. This trend has continued and today no heavy woodworking machinery is built for carshops, and practically all cars, both freight and passenger, are metal throughout.

DIRECT-CURRENT ELECTRIC MOTORS IN 1906

In the late 1880's and early 1890's, far-reaching developments were under way, such as the use of electricity for street lighting and operating streetcars. This was the beginning of our present method of power distribution and has affected life in general, and machine design in particular, more than any previous factor.

By 1906, direct-current motors running 720–900 or 1000 rpm were being used coupled direct to machine countershafts. A machine thus driven individually could be located in the most desirable position in regard to work flow, as it no longer was necessary to place it in relation to lineshafting which was often inconvenient and clumsy.

BALL BEARINGS BECOME AVAILABLE IN 1908

Another development of this time was our early automobiles. Free-running high-capacity ball or roller bearings, occupying small space and mounted in light dirtproof housings, were necessary for the successful operation of autos. These early trouble-free and hardened-steel sealed bearings were brought to the attention of wood-shop operators, resulting in their trial for woodworking machinery. Long bearing life, less frequent lubrication, cleanliness, and ease of replacement were a few of the advantages which brought about their rapid acceptance. Shorter, stiffer spindles and bearing housings, occupying less space, were all made possible by the use of ball bearings.

Ball-bearing arbors were first furnished as a desirable feature on jointers, to special order, as early as 1908. By 1923 they were available as standard equipment on most woodworking machines.

THIN HIGH-SPEED CUTTER KNIVES IN 1909

In 1909 thin high-speed knives mounted in circular cylinders, for jointers, surfacers, and molders began to appear. The safety of these, when used in jointers, was aggressively advertised and their use has saved many fingers and hands. The thin knives were locked in the cylinders by various designs of gibe and clamp screws, eliminating the danger of the broken knife bolts which were required with the thick knives previously used on the old square-type heads.

AUTO BODIES OF WOOD

Early auto bodies were built up of wood frames covered by light sheet-steel panels. The wood parts were of curved contours built up with special glue joints. The car manufacturers were constantly looking for more and better machines demanding special types for many of the peculiar operations required in standard body structure. The demand for machinery was further increased when closed bodies became popular, and lasted until the late 1920's when all-steel bodies replaced the composite construction.

ALTERNATING-CURRENT MOTORS IN 1919

The alternating-current electric motor, with no sliding parts other than the bearings, came on the market about 1919. The first of these motors used on woodworking machines were mounted direct on cutterhead arbors equipped with babbitt bearings. Bearing wear required adjustment to maintain the proper air gap between the rotor and stator and complicated the motor mounting. Ball bearings eliminated the necessity of this adjustment and their long life and other advantages were soon apparent.

COMBINATION OF MOTORS AND BALL BEARINGS PROVIDES IMPORTANT FLEXIBILITY, 1920–1930

Machines with cutter spindles mounted on ball bearings and driven by direct-mounted motors eliminated the use of belts which previously controlled the amount of adjustability of spindles. The self-contained motor-driven unit may be mounted for adjustment in any direction and can be quite compact. The comparison of the latest belted double-end tenoner and the motor-driven double-end tenoner, Fig. 25,

with that in Fig. 7 clearly shows the advantages. Between 1920 and 1930 nearly all woodworking machinery was redesigned for the incorporation of ball bearings and shaftless motors. Early users of these machines had considerable to learn about their operation and maintenance and, peculiarly, one of the hardest things to teach them was not to overlubricate the bearings. Some manufacturers recommended lubrication not oftener than once a month, but usually if a bearing showed any heat the first thing tried was to load it full of grease or oil, which only increased the temperature, until the excess lubricant was forced out of the housing. Today "sealed for life" ball bearings have eliminated this trouble.

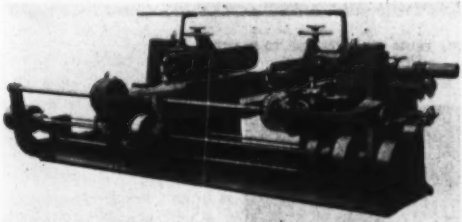
In the United States 60-cycle alternating current is standard except in a few localities. The 60-cycle current permits motor speeds of 3600 rpm maximum and multiples thereof ranging through 600, 900, 1200, and 1800 rpm. These speeds are theoretical and when the motor is loaded usually drop 3 or 4 per cent. The 3600-rpm motors therefore actually run about 3450 to 3500 rpm when fully loaded.

Most cutterheads when belt-driven ran from 4200 to 5000 rpm. Experience has shown that satisfactory results usually can be obtained at 3450. These results are made possible by the better bearings, more rigid construction, jointed knives, and ample power in the spindle.

MULTIKNIFE CUTTERHEADS VERSUS HIGH SPEEDS

Vertical spindle shapers require high speeds up to 10,000 and 12,000 rpm. The electrical manufacturers brought out a frequency changer which could be placed between the 60-cycle power line and the driven motor, modifying the frequency of the current so that motors could be run at any practical speed. Vertical-spindle shapers are usually equipped with 7200-rpm motors, while surfacers and molders were frequently run at 6000 rpm.

The availability of any desired speed, with ample power, provided designers with a new device. Some advocated high speeds with one or two knives in the head, not jointed. Others maintained that slower speeds and multiple knife heads, properly jointed, were the best. This controversy has never been fully settled, but most of our current woodworking machines are run with 60-cycle current at 3450 rpm.



No. 96 Double End Tenoner—*Quarter View (Back)*

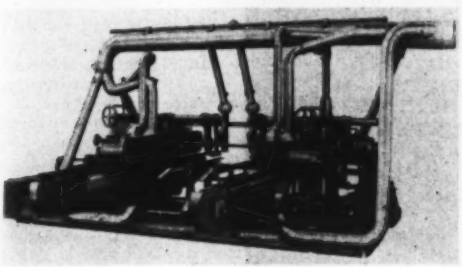


FIG. 25 DOUBLE-END TENONERS

(*Above*, latest type with belt drive, and *below*, full motor driven with dust-collector attachments. Courtesy Greenlee Bros.)

High speed, above 6000 rpm, increases mechanical difficulties such as proper balance, ball-bearing lubrication, and cuts down bearing life. If the speed is pushed too high, the advantages in quality or quantity of work do not justify the added maintenance costs.

ELECTRICAL CONTROLS

Each motor, mounted on the machine, required its control for starting, stopping, or reversing. When the frameless motors first came out they were smaller than their control cabinets. For single-motor machines the size of the control was unimportant, but when eight to a dozen motors were used, finding space in the machine for the controls became a problem. On these early machines controls frequently were mounted in cabinets hung on the wall or suspended from the ceiling. Electrical manufacturers soon brought out new controls, smaller in size, and arranged for group mounting so that cabinets may now be incorporated in the machine bases, providing dustproof-type enclosures acceptable for maintenance and checking.

SMALL-TYPE MACHINES FOR HOBBIES AND BENCHWORK

About 1923, the first woodworking machines were built in small sizes for hobbyists by a company in Milwaukee. Today these small-type machines are manufactured in several sizes in almost unlimited quantities at prices such that many people equip basement shops as a hobby. They have proved so valuable that many manufacturers use them for making small parts.

Following along this development, portable electric-motor-driven tools for many of the operations formerly performed by hand in the building trades have been developed. All of these are equipped with ball bearings, light in weight, and very practical.

ENDLESS V-BELTS

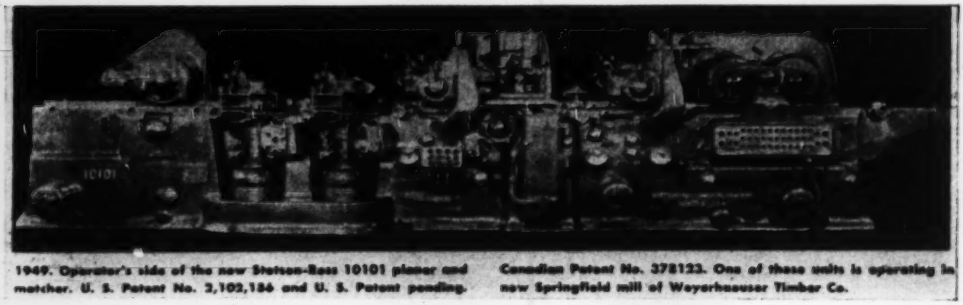
A new-type belt drive made its appearance about 1930 in the rubber V-belts. These now can be had with cotton, nylon, or steel cords, matched for length when used in multiples, and carefully balanced. This has permitted the designing of molders and other machines requiring different spindle speeds, and has eliminated the necessity of a frequency changer in the higher ranges. The steel-cord belts operate without any stretch, and all three types are a valuable contribution to our power-transmission systems.

HIGH SPEEDS, HOPPER FEEDS, AND CONVEYERS

Electrification of machines with high speed and rigidly supported spindles has permitted greatly increased feeds and produces excellent smooth surfaces. The planer and matcher, Fig. 26, is one of the later developments and will run up to 1000 ft provided the feed and discharge facilities are adequate. Fig. 27 shows the handling method at the infeed end of one of these matchers, consisting of disk chains, automatic tilting and loading hoist, transfer chains, and automatic feeding table.

Where molders are used running short lengths of work, hopper feeds are provided and the use of conveyers incorporated wherever possible.

In every line of manufacture, moving work materials through the plant requires as high as 25 per cent of the manpower employed; consequently, everything is being done to reduce material handling by adopting mechanical conveyer systems. Rough-mill rooms in furniture plants are set up with conveyers



1949. Operator's side of the new Stetson-Ross 10101 planer and matcher. U. S. Patent No. 2,102,184 and U. S. Patent pending. Canadian Patent No. 378123. One of these units is operating in new Springfield mill of Weyerhaeuser Timber Co.

FIG. 26 HEAVY-DUTY, MOTOR-DRIVEN PLANER AND MATCHER, 1949
(Courtesy Stetson-Ross.)

Modern planer infeed equipment including deck chains, automatic tilting unloader hoist (Pat. U.S. 2,317,000), transfer chains, and automatic feeding table.

FIG. 27 AUTOMATIC FEEDING BOARDS, FROM KILN TRUCK TO PLANER
(Courtesy Stetson-Ross.)

FIG. 28 AUTOMATIC SHAPER FOR CHAIR SEATS
(Courtesy Onsrud.)

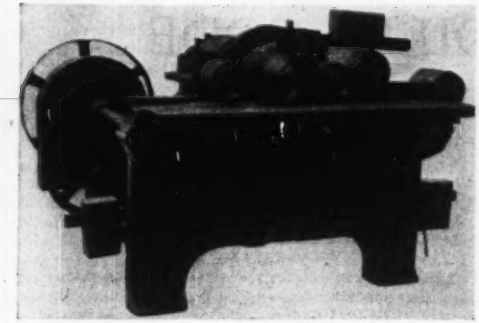


FIG. 29 EARLIEST CHAIN-FEED, BELT-DRIVEN, STRAIGHT-LINE RIPSAW
(Built in 1911 and still running. Courtesy Hermance.)

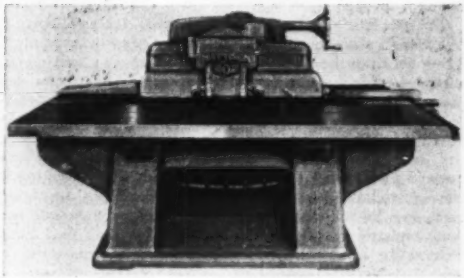


FIG. 30 CHAIN-FEED, MOTOR-DRIVEN, STRAIGHT-LINE RIPSAW 1950
(Courtesy Mattison.)

between the cutoff saws, ripsaws, and surface planers. In some cases the work is fed to the machine by the conveyer without an operator. In many sash-and-door plants an observer will note hopper feeds, by which the work is automatically returned to the operator's position.

EFFICIENT MACHINES OF TODAY

Automatic shapers with large rotary tables fitted with automatic air clamps, Fig. 28, will produce an amazing amount of work.

Ideas taken from the metalworking field, such as the V-ways of a lathe or metalworking planer, have been used for straight-line motion in double-end tenoners and straight-line ripsaws, improving the quality of work over the old style side-guided chains.

In the ripsaw, joints are produced suitable for gluing, thus saving in handling and eliminating the unavoidable losses of glue jointing. Fig. 29 (Hermance) shows the first chain-feed straight-line ripper built in 1911 and still running. Fig. 30 is one of the latest Mattison machines.

The double-end tenoner is probably the most versatile machine used in the woodworking industry. These machines can be had with innumerable attachments such as the dado attachment, both stationary and jump; relishing attachment; scoring-saw units; cam-operated shaping attachment; window-frame and sill-horning attachments; dovetailing attachments, and holdback chains for multiple cutting. The exhaust system for handling shavings is furnished as a regular part of the machine, saving considerable time in setting up and starting production on the machine. In one instance, only 3 hours were required to take a tenoner off a flatcar, connect it up both electrically and to the blower system, and get it in operation.

Carbide cutters have made a place for themselves and, when properly applied, run almost indefinitely without sharpening. Their use in saws and knives will increase as their qualities gain wider recognition.

WHAT OF THE FUTURE?

The many outstanding qualities of wood: its availability almost everywhere, its ready workability, its high strength/weight factors, its warmth and beauty, to mention only a few, have established wood as the most universally valuable raw material in the forward march of human progress. Our homes and our home furnishings are mostly of wood; much of our music is derived from instruments of wood, as is the major part of our sports equipment. Outside the home wood is adaptable to a myriad of useful applications. This appreciation of wood has grown over the years, and the best is yet to come.

Woodworking machinery has kept abreast of this amazing growth. The active and alert management of this industry can be relied upon to maintain, and even to accelerate, the rate of progress shown during the past century. Future woodworking machines will be more economical and efficient than they have ever been before.

ACKNOWLEDGMENT

The author sincerely regrets that this survey of 100 years has permitted the mention of only a few important types of woodworking machines, among the many in use. He is equally regretful that space prevents giving deserved credit to many of the members of the Association of Manufacturers of Woodworking Machinery, as well as to others whose accomplishments are equally worthy of mention.

The author's appreciation is extended to the many manufacturers of woodworking machinery who have so generously given of their time in preparing brief histories of their companies, and in furnishing past catalogs and circulars from which many of the data of this paper have been taken.

WITH a capacity of 120,000 ft of lumber in an 8-hour shift, and equipped with the first fully electric saw carriage drives in Ontario, the new sawmill at Cache Bay of the Geo. Gordon & Co., Ltd., a subsidiary of The International Nickel Company of Canada, Ltd., is regarded as one of the most modern and efficient in Canada.

The George Gordon mill, it is reported, utilizes just about everything but the bark. Knot-free trimmer ends and slabs, which would otherwise be waste, are cut into pickets for the manufacture of window-shade rollers; last year the mill produced 4½ million of these pickets. And waste material useless for pickets is chopped into chips and sold at the rate of 140 tons a day to the paper mill at near-by Sturgeon Falls for the production of corrugated paper and hardboard. Sawdust and bark are all the waste from the sawmill allowed to go to the burner.

About half the mill's production is high-grade white-pine lumber which is shipped to the general market. The other half, red pine, is used in the huge mining operations of The International Nickel Company in the Sudbury District, 55 miles west of Cache Bay. Inco, which requires as much as 77 million bd-ft of lumber a year, obtains a portion of its needs from the George Gordon mill.

THE ASME BOILER CODE

V Administration of the 1924 Edition of the Power Boiler Code—1925–1927

By ARTHUR M. GREENE, JR.

PRINCETON UNIVERSITY, PRINCETON, N. J. HONORARY MEMBER ASME

THE 1924 Edition of Section I, Power Boilers, of the ASME Boiler Code was bound with Section II, Material Specifications, the Appendix, and Section VI, Rules for Inspection. The Boiler Code Committee had decided earlier to print in separate bindings the 1923 Edition of Section IV on Low Pressure Heating Boilers; the 1921 Edition of Section III, Boilers of Locomotives; the 1924 Edition of Section V, Miniature Boilers; and the new Code for Unfired Pressure Vessels (Section VIII).

The 1924 Edition of the Code (Sections I, II, VI, and Appendix) was signed by twenty-three members. C. O. Myers (National Board of Boiler and Pressure Vessel Inspection), N. A. Carle (boiler users), and Wm. B. Reed (cast-iron heating boilers) were new members. Of the earlier committee members, Prof. Rolla C. Carpenter, Richard Hammond, and M. F. Moore had died, and A. L. Humphrey had resigned.

The Conference Committee had increased by this time from 13 to 35 members by the addition of representatives of twelve new states and eleven new cities. The added states were: Arkansas, Delaware, Hawaiian Islands, Indiana, Maryland, Michigan, Missouri, Oklahoma, Oregon, Rhode Island, Utah, and Washington. The new cities were: Chicago, Ill., Los Angeles, Calif., Memphis, Tenn., Nashville, Tenn., Omaha, Neb., Parkersburg, W. Va., Philadelphia, Pa., St. Joseph, Mo., Scranton, Pa., Seattle, Wash., and Tampa, Fla. Three subcommittees were listed in the Code, those on Materials (Specifications), on Steam Piping, and on Rules for Inspection. The Subcommittees on Welding, on Unfired Pressure Vessels, on Low Pressure Heating Boilers, on Boilers of Locomotives, on Miniature Boilers, and on Care of Boilers in Service were active, and the names of their members appeared in the separate printings of the codes prepared by them.

The page size of the new sections of the Code was made $5^1/_4$ in. $\times$ $7^3/_4$ in. for convenience of handling in the shop and office.

POWER BOILER CODE AND MATERIAL SPECIFICATIONS

Paragraph numbers for Section I of the Code were, in most cases, the same as those used in the 1918 Edition but were preceded by the letter "P." As the material specifications were now made a separate section, the old paragraphs 26 to 178 were omitted from the Power Section. In Section II, Material Specifications, the paragraphs were given new numbers, beginning with S-1 and extending to S-213. Paragraph numbers in the Appendix were changed and extended from A-1 to A-53. Pars. A-22 to A-53 were the same as former Pars. 378 to 409 of Part II (Existing Installations) of the 1918 Edition of the Code. These paragraphs were now called Suggested Rules (not mandatory). The 1924 Edition included the new Section VI on Rules for the Inspection of Materials and Steam Boilers, with paragraphs numbered from I-1 to I-60.

The three Sections I, II, and VI, and the Appendix of the 1924 Edition covered 175 pages and were accompanied by an index of 20 pages.

The 1924 Edition provided for the submission of specifications of materials other than those given in the Code whenever, in the development of the art of boiler construction, specifications for such materials became available for use. An attempt was made further to differentiate between firebox and flange steels. In Section II, Material Specifications, the paragraphs common to all ASTM specifications on inspection, rejection, reheating, ladle analysis, check analysis, and physical tests were covered in Pars. S-1 to S-4, so as to shorten the printing of the individual specifications. The specifications for boiler rivet iron, for stay-bolt iron, and for refined wrought-iron bars were replaced by one for Boiler Rivet, Stay-bolt, and Extra Refined Bar Iron which was substantially the same as ASTM A84-21.

ASTM specifications for steel pipe, for wrought-iron pipe, for copper plate, for copper bars for stay bolts, for seamless copper boiler tubes, for copper pipe, and for brass pipe were added as a result of the work of Subcommittees on Material Specifications, on Miniature Boilers, and on Steam Piping, Valves, and Fittings.

The 1924 Edition dealt also with piping and fittings used on the boilers up to the connections of the first valves from the boiler on steam outlets, feed lines, and blowoff lines. A new formula was added for computing the allowable working pressures for different sizes and thicknesses of lap-welded wrought-iron tubes for water-tube boilers or nipples, similar to that used for steel tubes in the 1914 Edition. A table and formula for copper tubes were given, while gages for steel or wrought-iron tubes for fire-tube boilers were listed for different allowable working pressures and various diameters.

The thickness of steam piping was given by a formula, and the requirements for feed pipes and blowoffs were covered in Pars. P-24 and P-25.

Seamless construction of drums, shells, and domes was permitted by Par. P-187, while the requirements for reinforcing plates for domes were fully given in Par. P-193. Dished heads and stay bolts adjacent to upper corners of fireboxes had been treated in more detail. The stays for the wrapper sheets of locomotives were now designed in a new and extended manner as developed for the Code by the American Locomotive Company. Many paragraphs had been altered for clarification or to make them more definite, as a result of study or replies to cases.

A number of the paragraphs on safety valves were reworded as the result of the conferences with representatives of the manufacturers. The three tables on relieving capacities of

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Chapter 5 of a history of the ASME Boiler Code, prepared for the Boiler Code Committee of The American Society of Mechanical Engineers. Chapter 1, which dealt with the antecedents of the Code, appeared in MECHANICAL ENGINEERING, July, 1952, pp. 555–562; Chapter 2, which told how ASME set up the Committee and adopted the first Code of 1914, appeared in August, 1952, pp. 640–646; Chapter 3, which dealt with the administration of the first Code from 1915–1918, appeared in September, 1952, pp. 727–734; and Chapter 4, describing how ASME expanded the Boiler Code from 1919 to 1924, appeared in November, 1952, pp. 897–907.

safety valves at different pressures were replaced by a small one.

There were practically no changes in the Appendix beyond the addition of the Rules for Existing Installations (Part II of the 1918 Edition of the Code). The volume closed with Section VI on Rules for Inspection.

COMMITTEE PROCEDURE

In accordance with the method of revision developed during the period 1924–1927; the 1927 Edition was to be made from addenda. These addenda were published in MECHANICAL ENGINEERING, and thus submitted to the membership of ASME. After these addenda had remained open for suggestion they were revised if necessary and then submitted to the ASME Council. When approved by the Council they became effective and part of any new printing of the Code. At a later date the Council added to its vote of approval the phrasing that they "be adopted as standard practice." Thus without a public hearing the 1927 Edition was prepared from addenda submitted to the Council on Dec. 6, 1926, and April 4, 1927. The edition was actually printed in December, 1927, so that control by the 1924 Edition of the Code extended from March, 1924, to December, 1927.

In the three years, 1925 to 1927, the number of meetings averaged $8\frac{1}{3}$ per year. These meetings were attended by 13 of the 23 members of the Committee, 2 of the 35 members of the Conference Committee, 1 of the 3 members of the Subcommittee on Material Specifications, and about 4 visitors. During this period 97 Cases were considered, Cases 479 to 575, an average of 33 Cases per year.

Addenda to some sections of the Code became items in the minutes of the Boiler Code Committee at each meeting beginning with those of Jan. 14, 1925, dealing with addenda to the Heating Boiler Section of the Code relative to the sizes of the safety valves based on grate area. At the meeting of Sept. 18, 1925 (Item 1302) the Boiler Code Committee voted "that all revisions that have been reported to the Committee, passed the usual ballot, and have been published in MECHANICAL ENGINEERING and stood for over thirty days without any objections are to be reported to the Council for publication as revisions and issued in data-sheet form as addenda for general distribution."

During this period, 1925 to 1927, the addenda proposed were subjected to discussion by members of the Boiler Code Committee. When publication brought serious criticisms and objections, Committee hearings and discussions were held after which the addenda were approved, modified, or withdrawn. By this means the 1927 Edition of Section I, Power Boilers; Section II, Material Specifications; Appendix; and Section VI, Rules for Inspection, were issued in a single volume. The 1927 editions of Section III, Boilers of Locomotives; Section IV, Low Pressure Heating Boilers; Section V, Miniature Boilers; and Section VIII, Unfired Pressure Vessels, were issued as separate publications without public hearings.

BOILERS OF LOCOMOTIVES

Earlier, a 1926 Edition of Section III, Boilers of Locomotives, had been issued with the same letter of transmittal as was used in the 1921 Edition and with the same signatures: Vaughan,[1] Cole, Kiesel,[1] Partington,[1] Rushton, and Wille. It was changed slightly by a few addenda. Two figures showing methods of determining net areas of heads for staying and one on acceptable forms of rivet heads were included. The 1927 Edition of Section III was signed by James Partington,[1] *chairman*, H. B. Oatley, and A. G. Pack. In it there was only one very slight addition to that of 1926 giving the sizes of the letters and figures used in stamping by the inspector. This edition had 31 pages of text, to which was attached a 7-page index.

LOW-PRESSURE HEATING BOILERS

The 1927 Edition of Section IV, Low Pressure Heating Boilers, incorporated a number of revisions of the 1923 Edition of that section which had been published on the pink addenda sheets approved by the ASME Council as well as others more recently completed and approved. It was signed by S. F. Jeter,[1] *chairman*, R. W. Birchfield, W. H. Boehm,[1] C. E. Gorton,[1] F. B. Howell,[1] M. F. Moore,[1] and O. T. Nelson.

This edition was changed slightly in a number of places. The important changes were: the removal of the 60-in. limitation on the diameter of a steel-plate heating boiler, the inclusion of Specifications for Steel Plate of Flange Quality for Forge Welding and for the Base Metal in Autogenous Welding, the basing of the relieving capacity of safety valves on grate area rather than radiating surface, and formulas for the thickness of copper tubes. An index of 7 pages was included.

There were few changes relating to autogenous welding as this art had not been developed sufficiently to warrant additions to the Code.

MINIATURE BOILER CODE

The 1927 Edition of Section V, Miniature Boilers, was signed by the members of the Subcommittee on Miniature Boilers: Charles E. Gorton,[1] *chairman*, James Partington,[1] *vice-chairman*, William P. Eales, William H. Furman, Sherwood F. Jeter,[1] Casin W. Obert,[1] and John H. Plunket. This section had only a few changes from the editions of 1922 and 1924, made from interpretations. It had paragraphs marked M-1 to M-15 covering 8 pages with the former appendix of two pages giving the gas-burner specifications of the American Gas Association and the form of the Manufacturers' Data Report. A three-page index was included.

UNFIRED PRESSURE VESSELS

The 1927 Edition of Section VIII, Unfired Pressure Vessels, incorporated the few addenda of the three-year period regarding safety valves, minimum thickness of shell plates, longitudinal riveted joints, stamping, data sheets, strength of joints, flanges of heads, and a new specification for steel of two grades to be used in welding. Autogenous welding was receiving much attention during that period as will be noted later, but the results of investigation were not sufficiently extensive and definite to warrant revision at that time. This section was signed by members of the Subcommittee: E. R. Fish,[1] *chairman*, Wm. H. Boehm,[1] C. E. Bronson,[1] S. F. Jeter,[1] and James Neil.

SUGGESTED RULES FOR CARE OF POWER BOILERS (SECTION VII)

The care of boilers in service was part of the original full title of the ASME Boiler Code, and, as was reported in the previous chapter, the Subcommittee to prepare such rules was appointed by the ASME Council on Jan. 7, 1922.

At a meeting of the Boiler Code Committee on Feb. 20, 1925, F. M. Gibson, chairman of the Subcommittee, reported that it had held a two-day session and had revised the earlier draft for the public hearing at Montreal in 1923 to consider oral and written suggestions. It had approval of the suggested changes from conferring organizations. It requested approval by the Boiler Code Committee for submission to the ASME Council to approve the report for publication in MECHANICAL ENGINEERING. This printing would be made before its presentation at a public hearing at the 1925 ASME Spring Meeting at Milwaukee in May. This proposed set of rules covered 48 typed

[1] Member of Boiler Code Committee.

[1] Member of Boiler Code Committee.

pages. It contained numbered paragraphs C-1 to C-338, and an appendix of 9 pages with numbered Pars. CA1 to CA31. The proposed rules were approved for printing in MECHANICAL ENGINEERING. They were signed by F. M. Gibson, *chairman*, E. G. Bailey, W. G. Diman, V. M. Frost,[1] J. R. Gill, J. W. Hayes, S. F. Jeter,[1] W. H. Larkin, Jr., M. F. Newman, Cyrus W. Rice, J. S. Schumaker, H. F. Scott, and N. Stahl.

The Subcommittee had sent the suggested rules to more than 300 interested parties and had waited five weeks after the public hearing at Milwaukee for comments and criticisms. The criticisms were considered at a meeting of the Subcommittee and on Sept. 18, 1925, it presented to the Boiler Code Committee nine pages of changes or additions to certain of the 338 numbered paragraphs and five pages of changes to the 31 paragraphs of the appendix. One question which had to be brought to the Boiler Code Committee for decision was that relating to Pars. C-315 and C-316 on the intercommunicating valves between pipe systems with steam at different pressures. Another question was on the subject of caustic embrittlement and the statement of Par. CA-5. The Permutit Company objected to the statement of Par. CA-5 although it had been approved by the other members of the Associated Manufacturers of Water Purifying Equipment, the American Boiler Manufacturers Association, members of the Prime Movers Committee of the National Electric Light Association, and others.

S. B. Applebaum of the Permutit Company presented at the September, 1925, meeting, a communication giving his reasons for objecting to Par CA-5. He pointed out the origin of the paragraph, cited best foreign theories and tests bearing on failures at seams, and offered suggestions for a rewording of Par. CA-5.

E. M. Kerr of the B. & W. Company read correspondence indicating that some cracking such as was characterized as caustic embrittlement was known and experienced in German boiler practice.

Professor Williams of Massachusetts Institute of Technology gave a brief account of his research work showing that embrittlement of steel had a definite relation to caustic-soda concentration.

The rules as originally published with the changes reported at this meeting and reference to the objection of the Permutit Company were accepted by the Boiler Code Committee. They were approved by the ASME Council on Jan. 13, 1926, and again for second printing on Dec. 5, 1927.

The rules were prepared to assist operators of steam boilers in maintaining their plants in as safe a condition as possible. The subject of economy received only incidental consideration. The difficulty in formulating a set of rules that might be applicable to all sizes and types of plants was recognized, and therefore these rules were suggestive only and it might be advisable to depart from them in certain cases.

Section I, Rules for Routine Operation, contained Division I, on Putting Boilers in Service with 15 numbered paragraphs on Getting Up Steam and one on Cutting In. Division II, on Handling Boilers in Service, had one numbered paragraph on Firing, one on Cleaning Fires, one on Banking Fires, four on Water Level, one on Wet Steam from Foaming and Priming, one on Oil in Boiler, one on Feedwater Treatment, two on Blowing Down, one on Leaks, one on Repairs, and two on Removal of Soot and Ashes. Division III, Handling Boilers Out of Service, had one numbered paragraph on Cutting Out, one on Emptying, one on Cleaning, and one on Laying Up.

Section II, Rules for Operation and Maintaining Boiler Appliances had five numbered paragraphs on the Steam Pressure Gage, eight on Water Glasses, one on Feedwater Regulators, one on Fusible Plugs, twelve on Safety Valves, nine on Blow-Off Equipment, five on Dampers, and six on Banking Fires.

Section III, Rules for Inspection, covered six numbered paragraphs on General Matters, six on Preliminary Matters, eight on External Inspection, seven on Internal Inspection, six on Furnace and Parts Exposed to the Fire, three on Appurtenances, and three on Care and Management.

Section IV, Rules for the Prevention of Direct Causes of Boiler Failure, under the heading of Over Pressure, dealt with indicators, relief equipment, water supply, excessive combustion, and operation. Under the heading, Weakening of Structure, the subjects of overheating, feedwater supply, feedwater treatment, internal corrosion, external corrosion, erosion, stresses other than those from internal pressures, and mechanical injuries were treated in detail.

Section V, Partial Rules for Installation, contained 43 numbered paragraphs. It covered boilers, steam pressure gages, water glasses, safety valves, intercommunicating valves, feedwater supply, dampers, fuel supply, blowoff line and valves, support of structures, pipe-line supports, stack supports, and belting and shafting supports. The appendix of 27 numbered paragraphs was devoted to feedwater analysis, treatment, and control. This made a book of 88 pages.

CHANGES IN PERSONNEL

At the meeting of March 14, 1924, John A. Stevens presented a letter of resignation as Chairman of the Boiler Code Committee. He called attention to the fact that he had served to the best of his ability since Aug. 8, 1911, and had put into that service all the time and energy he could spare from his own work. He gave as additional reasons for his resignation the subconscious feeling that another chairman might secure better results than he could in the future. He believed that a change every so often was for the good of the service, and he wished to divide the honors of the chairmanship of the Boiler Code Committee with others. He wished it to be distinctly understood by everyone that the reasons he had given were the only ones prompting his resignation.

Mr. Stevens' resignation was received by the members of the Boiler Code Committee with expressions of regret and protest, but no action was taken until June 17, 1924, when a resolution signed by twenty members was addressed to him requesting him to remain as chairman of the Committee. This resolution was endorsed by the ASME Council. From Sept. 16, 1924, Mr. Stevens continued active as chairman until Sept. 18, 1925, when at his request the resignation was finally accepted by the ASME Council on Oct. 1925, with thanks for his devoted service. A specially engrossed set of resolutions of appreciation was presented to Mr. Stevens at the Council meeting of Nov. 30, 1925, and he was appointed Honorary Chairman of the Boiler Code Committee. Fred R. Low was appointed chairman to succeed him.

COMMITTEE CHANGES, 1925–1927

Elbert C. Fisher, a member of the Advisory Committee of 1914 representing Scotch-marine and other types of boilers, died on May 18, 1925, after years of arduous and most impartial service on the Boiler Code Committee. He was succeeded on the Boiler Code Committee by H. E. Aldrich, who was appointed on Sept. 16, 1927, and as chairman of the Subcommittee to confer with the American Marine Standards Committee, by V. M. Frost. The resignations of F. H. Clark and W. F. MacGregor were accepted by the ASME Council on March 16, 1925. J. O. Leech was appointed a member of the Boiler Code Committee on May 13, 1925.

On Oct. 3, 1925, as Messrs. Partington and Wille were the

[1] Member of Boiler Code Committee.

only members remaining of the Subcommittee on Boiler Locomotives and as Mr. Wille wished to be relieved, new members were suggested. H. B. Oatley was appointed on Nov. 30, 1925, and A. G. Pack, as a "conference" member, on June 4, 1926.

On Nov. 30, 1925, R. H. Hopkins, Jr., was appointed to the Subcommittee on Welding on the resignation of M. W. Kellogg, and A. M. Candy and L. A. Sheldon were also appointed as members of that Subcommittee.

On the resignation of James Partington from the Subcommittee on Material Specifications on Nov. 26, 1925, C. L. Warwick and Arthur M. Greene, Jr., were appointed to the Subcommittee on Jan. 9, 1926.

After many effective years as chairman of the Subcommittee on Welding, F. C. Fairbanks resigned on April 25, 1925, and James Partington was appointed chairman and A. S. Kinsey a member of this subcommittee.

On Jan. 8, 1926, W. F. Durand of California was appointed to the Boiler Code Committee.

W. F. Durand, R. S. Daugherty, E. R. Fish, S. F. Jeter, and D. S. Jacobus were appointed by the ASME Council on April 30, 1926, to a subcommittee to work with the American Welding Society. On June 4, 1926, John H. Deppeler and Dr. Comfort A. Adams were added to the Subcommittee on Welding and Wm. P. Eales to the Subcommittee on Miniature Boilers.

On May 4, 1926, James Partington and C. W. Obert were appointed by the ASME Council to represent the Boiler Code Committee on a Gas Welding Committee of AWS.

William B. Reed of the Boiler Code Committee died on Aug. 4, 1926, and was replaced by Frank B. Howell of the National Boiler and Radiator Manufacturers Association on Feb. 18, 1927.

R. E. Cecil was appointed on Dec. 2, 1926, to the Subcommittee on Welding as a representative of the brazing interests.

C. W. OBERT RESIGNS AS SECRETARY

At the meeting of June 24, 1927, the Boiler Code Committee received a letter dated June 21, 1927, from C. W. Obert. In that letter Mr. Obert resigned as secretary of the Committee, a post in which he had served efficiently and faithfully for 16 years. The committee regretted that this resignation would deprive it of the effective services of Mr. Obert but in view of the personal advantages to him in other fields of labor, it could do nothing but accept it to become effective about Sept. 1. The Committee recommended to the ASME Council that Mr. Obert be appointed a member of the Boiler Code Committee. Resolutions regarding the significance of the services of Mr. Obert to the Boiler Code Committee were presented to him at the meeting of Sept. 10, 1927. These were prepared by C. L. Huston, Wm. H. Boehm, E. F. Miller, and J. A. Stevens. The ASME Council also entered in its minutes of Aug. 29, 1927 its regrets over the resignation of Mr. Obert and its appreciation of his services. It also appointed him a member of the Boiler Code Committee. On Sept. 17, 1927, he was appointed Honorary Secretary of the Committee.

Miss Martha Jurist, who had been in charge of the office work of the secretary, was appointed acting secretary. Mr. Obert consented to act as an adviser to the acting secretary, as his employer, The Carbide and Carbon Corporation made sufficient time free for him to attend meetings of the Boiler Code Committee and to aid Miss Jurist in the work of the secretary.

TEST TO DESTRUCTION UNDER PAR. P-247

Requests for tests to determine the maximum allowable working pressure of a boiler structure or any part thereof, when no rules were given or the calculations of it could not be made within a reasonable degree of accuracy, had been made three times during the period 1925–1927. There were two requests for tests of header boxes, one of forged steel and one of cast steel, and one request for the testing of a special design of brace carrying the load from flat side surfaces of a boiler. Answers were given to the applicant in each case.

In the tests to determine the maximum allowable working pressure for such structures reports were made to the committee by its representatives who witnessed the tests. As mentioned earlier, some of these reports were made in great detail. However, the methods of the tests and the interpretation of the results were dependent upon the representatives making them and differed from one another. On Sept. 24, 1926, a three-page communication (Item 1404) from Dr. D. S. Jacobus was submitted to the Boiler Code Committee outlining a proposed standard practice for the conduct of such a test in accordance with Par. 247 covering materials, workmanship, preparation for test, the hydrostatic test, physical characteristics of metal, plotting curves, determining minimum elastic limit, determining maximum allowable pressure, retests, and testing without endangering the structure. The importance of this communication was evident and a special committee of S. F. Jeter, *chairman*, Perry Cassidy, E. R. Fish, and Arthur M. Greene, Jr., was appointed to study the outline of standard practice and report to the Boiler Code Committee on the most suitable method of applying it to the hydrostatic test of headers and other pressure parts. This committee made its first report at the meeting of Dec. 3, 1926, and suggested slight changes in seven of the items. The Committee then directed that the revised proposed standard practice for making hydrostatic tests of a header or of other pressure parts be furnished each member of the Boiler Code Committee, and the boiler manufacturers who were in a position to apply it, for comments or suggestions. The Boiler Code Committee also invited the manufacturers to attend the meeting at which the final report was to be made.

On March 16, 1927, S. F. Jeter reported that the special committee was considering the comments which had been received regarding their first report and the Boiler Code Committees directed that the report be made to the Executive Committee and then submitted by it to the whole Committee for letter ballot because of the importance of the subject. This letter ballot resulted in no criticisms by the time of the meeting of May 20, 1927, at which it was approved for publication in MECHANICAL ENGINEERING.

UNFIRED PRESSURE VESSEL CODE IN CALIFORNIA

Throughout the three-year period 1925–1927 the subjects of welding methods and permissible stress values, two qualities of steel and the exclusion of high-temperature vessels were before the Subcommittee on Unfired Pressure Vessels. Few changes were incorporated. One of the subjects of discussion and concern was the request from E. G. Sheibley, Chief of the Industrial Accident Commission of California, for the opinion of the Boiler Code Committee on certain modifications to the Code for Unfired Pressure Vessels suggested by their Subcommittee on Welding with a view to their adoption of Section VIII. The Boiler Code Committee reported that the Accident Commission desired the Code to be made less demanding, but the request was referred to the Subcommittee on Unfired Pressure Vessels at its meeting of June 5, 1925.

A letter dated Aug. 8, 1925, to Mr. Sheibley gave the history of the development of the Code for Unfired Pressure Vessels through five preliminary printings leading to the final sixth printing of the 1924 Code.

On Aug. 15, 1925, Mr. Sheibley stated that tentative Rules on the Construction of Air Pressure Tanks had not been completed for public hearings.

The attitude of the Commissioner and the engineering fraternity of California regarding the Unfired Pressure Vessel Code was discussed on Dec. 5, 1925, with Dr. W. F. Durand of Palo Alto, Calif., President of ASME, and Prof. R. L. Daugherty of Pasadena, Calif. It was shown that some wished co-operation, some verbatim acceptances, although there was some opposition to the limitation put on welding. Some would accept rules if there were special rules for training welders and supervisory work which could be adopted and with which higher stresses should be allowed. The appointment of Dr. Durand to the Boiler Code Committee was made so that there would be a member of the Boiler Code Committee in California who could transmit the thoughts of the Subcommittee to those who would have to formulate the new rules or adopt the ASME Code.

On receiving a letter of April 12, 1926, from E. G. Sheibley regarding the tentative revision of the Air Pressure Tank Safety Orders of the Commission and the meeting of its revision committee, the Boiler Code Committee expressed its pleasure at the details of the proposed changes and offered to co-operate or assist in any other way. This letter told of its joint research committee with the American Welding Society to co-operate in tests by the Bureau of Standards on welded vessels which would enable the Boiler Code Committee to change the limitations of Pars. U-23 and U-68. The letter commented favorably on the proposed California rules which provided for the examination of welders, a permanent record of their work, and the approval of the manufacturer fabricating the welded vessels. This would justify the Commission in asking for allowance in proportions, stresses, and other conditions of Pars. U-23 and U-68. This reply was considered by S. W. Miller of the Sub-Committees on Welding and Unfired Pressure Vessels, and in a letter of Nov. 23, 1926, he pointed out changes which could be made in the Unfired Pressure Vessel Code. These included the omission of Class B vessels, and retaining $\frac{5}{8}$ in. as the maximum thickness for welded plates. Only two of the elements, diameter, pressure and stress, should be specified in the rules and the working stress of 8000 psi for double-V welds should be allowed.

On Jan. 28, 1927, E. G. Sheibley wrote the Boiler Code Committee that the Industrial Accident Commission of California was sending a copy of the proposed revision of the ASME Unfired Pressure Vessel Code to ascertain the opinion of the Boiler Code Committee on this form for the purpose of co-operation. This revision contained 21 typewritten pages and blueprints. It was reported at the committee meeting of Feb. 18, 1927. Dr. Jacobus, Chairman of the Executive Committee had directed that S. W. Miller be requested to review this modified draft. Mr. Miller, who was present, gave an outline of his study. The draft embraced a complete rearrangement of the subjects so as to group the text under the headings: application, design, construction, installation and operation and recommendations. Although the order of subjects had been entirely rearranged, Mr. Miller stated that from a careful comparison of the text matter of the draft it appeared that about 85 per cent of the text was identical with that of the original ASME Unfired Pressure Vessel Code. The remaining 15 per cent was new and would require careful consideration by the committee. Some of the new material was in line with the more liberal recommendations of the American Welding Society. The Boiler Code Committee then directed that a letter of acknowledgment be drafted calling attention to the careful consideration of the subject matter by the Committee and to its belief that the draft should be reviewed before any comment could be made. It assured the Commission that prompt and thoughtful consideration would be given to its suggestions. It thanked the Commission for its wholehearted co-operation, and expression of confidence and interest to the Boiler Code Committee. Mr. Miller was requested to make a careful study of the drafts and draw up recommendation to be incorporated in the official response to Mr. Sheibley.

On March 18, 1927, Charles E. Gorton of the Boiler Code Committee reported on the California situation as he had found it on a recent visit to the state. As other recommendations made by Mr. Miller were to be considered by the Executive Committee both of these matters were referred to it and Mr. Miller's recommendations were referred also to the Subcommittee on Unfired Pressure Vessels. At the meeting of April 15, 1925, the letter of reply drafted by the Executive Committee was approved. This letter commented on the fact that the proposed California Rules were in the main identical with those of the Code for Unfired Pressure Vessels and contained added matter under the provisions outlined in a previous letter from the Boiler Code Committee dated May 1, 1926, which gave precautions to insure good welding and were in tentative form pending the results of the proposed tests by the Bureau of Standards. The Boiler Code Committee recommended that the new rules limit the working air pressure to 250 psi, the inside diameter to 60 in., and the maximum shell thickness to $\frac{5}{8}$ in. The Committee, noting that the rules related only to air tanks, called attention to the revisions in the Code for Unfired Pressure Vessels that bore on the proposed California rules, and called attention to certain clerical errors.

At the meeting of Oct. 28, 1927, it was reported that the revised California Rules for Air Pressure Tanks had been received and that public hearings would be held in San Francisco on Nov. 9, and at Los Angeles on Nov. 15, 1927. The rearranged form and its departure from the ASME Code for Unfired Pressure Vessels in certain respects were noted. Again S. W. Miller was requested to review the revised code so as to advise the Executive Committee on any action it should take.

On Dec. 2, 1927, it was announced that since Mr. Miller had communicated with the California Commission regarding certain orders of their new rules, no further action of the Boiler Code Committee was necessary. In a letter of Nov. 17, 1927, to the Committee Mr. Miller had advised that the rules were open at Public hearings he had advised the Commission regarding errors in Orders 912-5 and 918-7, Structural Steel for Bridges, in Order 918-11, in which the allowable stress in welded joints for tanks was set at 7200 psi, or less than 8000 psi as recommended by the Boiler Code Committee, and in Order 918-46, the temperature of annealing. These criticisms had resulted in the elimination of objectionable features. In main the rules were identical with those of the Unfired Pressure Vessel Code, and with the changes suggested in the few orders mentioned they would be satisfactory for California.

SUGGESTED REVISIONS

Objection to the Unfired Pressure Vessel Code by the American Petroleum Institute was made on Jan. 14, 1925, through A. D. Young, its secretary, and resulted in the exemption of pressure vessels for pressures above 600 psi. At that meeting the electric-welding industry suggested certain changes which could not be made at that time; but a statement appeared in the preamble to the effect that "Rules for joints of the double-welded lap type and for electric-induction-compression welding are in process of preparation and will be submitted later on for addenda to the Code."

Recommendations for revisions of the Unfired Pressure Vessel Code were received on Sept. 14, 1925, from the American Bureau of Welding regarding the several items on fusion welding on which full agreement could be reached.

The manufacturers of forged-welded vessels, in communica-

tions of June 29, 1921, stated that although they had agreed to the paragraphs of the Code they now found that there should be changes in the maximum allowable unit stresses and in the physical and chemical properties of the steel which could be obtained by using the ASTM specifications covering two grades of steel.

The American Electric Railway Association through its Committee on Specifications for Air Reservoirs asked on Sept. 11, 1925, for a change in the diameter of tanks of 1/8-in. shell thickness from 14 in. to 16 in. These suggestions were referred to the Subcommittees on Unfired Pressure Vessels and Welding. The Subcommittee on Welding recommended that 8000 psi be the allowed stress for double-V welds, that in Par. U-23(a) the diameter be increased to 60 in., that the pressure limit be 200 psi when the temperature did not exceed 250 F, that the length be unlimited, and that no mention be made of the material stored in the tank.

The Subcommittee approved the inclusion of Specification ASTM A89-23T and recommended that a stress of 8500 psi be allowed in Grade B material of 50,000 psi. It also recommended that 8000 psi be allowed in Par. U-82. The Subcommittee recommended that in view of the allowable stress of 8000 psi the diameter with 1/8-in. steel plate be increased to 16 in.

AUTOGENOUS WELDING

The use of x-rays for the examination of steel castings for the Boston Edison Co. at the Watertown Arsenal was reported by I. E. Moultrop to the Boiler Code Committee on Jan. 14, 1925. The castings were to be used at 1200 psi. A steel valve which was believed to be perfect had been found by x-ray examination to be defective. The discussion led to the formulation of a letter to the ASME Council calling attention to the value of this new tool for inspection and the value to the profession and industry of the availability of such expensive equipment at a Government plant. They pointed out the need for x-ray apparatus of higher voltage and urged the Council to extend its support to an application for an appropriation to the Ordnance Department of the U. S. Army for more powerful x-ray equipment.

The American Bureau of Welding planned to reorganize its Pressure Vessel Committee which would carefully review the 1924 Edition of the ASME Unfired Pressure Vessel Code and suggest a modification of the rules which it thought unduly restrictive. It had planned a program of investigation which would give complete, technical, and scientific evidence to warrant their suggested modifications.

At the meeting of the Bureau of April 24, 1925, Dr. D. S. Jacobus, chairman of the Executive Committee of the Boiler Code Committee, was asked by Prof. C. A. Adams to speak on the attitude of the Boiler Code Committee toward such an investigation.

COMMITTEE ATTITUDE

Dr. Jacobus discussed the manner of making interpretations and revisions according to the procedure of unanimous agreement and the national extent of application of the Code. He called attention to the development of the Code for Unfired Pressure Vessels and the necessity of conservative progress, as this Code and others had to be adopted by many states and municipalities. A code which was too liberal because of the lack of scientific backing would not be adopted by them. He pointed out that good welding could be done by a well-organized shop, but the Code must be such that requirements would yield safe vessels whenever made. He discussed competent welders and the way in which an inspector could be sure of the proficiency of a workman. The great handicap of the Boiler Code Committee in formulating the Code had been the lack of agreement of the welding industry on some of the points at issue. Some of these had been cleared up by the Bureau of Welding by its former tests at the Bureau of Standards. The Boiler Code Committee was not opposed to fusion welding and would revise the Code whenever the industry could agree on the results of experiments on vessels. It would heartily co-operate with all interested organizations and the American Bureau of Welding in improving the Code.

PROPOSED TESTS

In a letter of Dec. 2, 1925, A. G. Oehler, president of the American Welding Society, called the attention of W. L. Abbott, President of ASME, to a comprehensive series of investigations to secure data and information regarding welding which were still lacking after the tests on some 40 tanks reported in Bulletins of the American Welding Society. To carry out these investigations, funds must be raised from interested parties and the necessary material and tanks must be secured. The U. S. Bureau of Standards had consented to carry out the work and to allow H. W. Whittemore to act as chairman of the subcommittee of the American Bureau of Welding which would have immediate charge of the work. The National Research Council, through its Division of Engineering and Industrial Research, was to act as treasurer of the funds.

Dr. F. B. Jewett, chairman of the Division of Engineering, secured the approval of the National Research Council to care for funds provided: (*a*) it assumed no responsibility for raising the funds; (*b*) definite assurance be given that there was a real need for the investigation; and (*c*) that if patentable discoveries resulted, such patents would be subject to the general policy of the National Research Council.

The Boiler Code Committee approved this program (letter of Jan. 11, 1926) and stated that the results of the tests would be considered in revisions of Codes. In the letter of approval the Committee suggested the advisability of examinations of welds by x-ray analyses and also the use of a breathing test.

The program presented provided for tests of tanks of 3/8-in. plate, 2 ft in diameter and 6 ft long. Tests to destruction were planned with a gradual increase of pressure and with hammering at intervals.

Interested manufacturers were to furnish three of each of the following types of tanks: (1) Lap-welded seams; (2) single-V tanks automatically welded; (3) single-V tanks hand-welded on one side; (4) single-V tanks hand-welded with slight wash weld on inside; (5) electric-compression-induction welds; (6) riveted tanks; (7) riveted welded tanks; also a few special tanks 6 ft in diameter, 12 ft long, with plate material of 1/2 in., 3/4 in., and possibly 2 in. thick and a few high-pressure tanks designed for 500 psi.

Fatigue tests were to be made on a number of wide specimens, on riveted joints, double-V joints, single-V joints automatically welded, lap-welded joints, single and double-rivet-welded seam joints, combined rivet-welded and seam-welded joints.

Fatigue and other physical tests were to be made at high temperatures and also with varying temperature.

Tensile tests were to be made on specimens ranging in thickness from 1/4 in. to 2 in., including various types of joints and methods of welding.

The testing at the Bureau of Standards was to be made under the direction of a Pressure Vessel Committee of the American Welding Society of which H. C. Whittemore of the Bureau of Standards was to be chairman.

On March 19, 1926, the Boiler Code Committee accepted the invitation of the American Welding Society to nominate five members of ASME to be appointed to the Special Joint Committee on Fusion Welding for Pressure Vessels. The members

nominated were R. L. Daugherty, William F. Durand,[1] E. R. Fish,[1] D. S. Jacobus,[1] and Sherwood F. Jeter.[1]

The full committee contained five members from the American Welding Society, five from the ASME, one each from 16 organizations, and three independent experts. Its organization meeting occurred on Dec. 9, 1926.

H. W. Whittemore, chairman of the Subcommittee on Tests of the Joint Research Committee on the Welding of Pressure Vessels reported on a less intensive tentative test program on Mar. 20, 1927. Tanks would be restricted to one size, 2 ft in diameter and 6 ft long, designed for 250 psi. The stress at the working pressure was to be 8000 psi. There were to be four duplicate tanks of each kind tested. The first tank would be used for cutting up and determining the magnitude of the stresses in the tanks resulting from welding or other methods of forming the joints. The second tank was to be tested in accordance with the Code for Unfired Pressure Vessels under pressures up to $1^1/_2$ times the working pressure, hammered as required by the Code. The pressure was then to be increased to three times the working pressure, and the tank was then to be tested under increasing pressures up to the bursting pressure. The third tank was intended for the breathing test suggested by the Boiler Code Committee. The fourth tank was to be kept for future test which might be planned.

In response to a request for suggestions from the Boiler Code Committee for the variation of pressure in the breathing test, the Committee recommended that with a designed stress of 8000 psi in the solid plate it would recommend for one million reversals a variation from 50 to 150 per cent of the working pressure. It was suggested that on completion of the million reversals the tanks would be held for further tests if desired.

The Boiler Code Committee on June 25, 1927, recommended R. E. Cecil for appointment to the Subcommittee on Procedure, of the Joint Research Committee of the American Welding Society because of his broad experience in welding and in consequence of his letter of June 7, 1927, in reference to the proposed tests and the extent of their interpretations.

A still further revised program of tests at Washington was submitted to the Boiler Code Committee for its approval in October, 1927, as the National Research Council had made this a prerequisite to accepting the responsibility of acting as treasurer for the fund. In December Dr. Jacobus reported that a formal report of approval should be prepared by the Executive Committee.

At the meeting of Dec. 3, 1926, the Boiler Code Committee considered a letter dated Nov. 6, 1926, from John Anderson, president of the Milwaukee Electric Railway and Light Company, to W. L. Abbott, president ASME, regarding the fabrication of drums for high-pressure (1400 psi) water-tube boilers by a patented fusion-welding process developed by the A. O. Smith Company and asking for an examination of the work of this company. The answer to this noted the value of such work for thick drums and suggested a test of a small section of one of them at the Bureau of Standards. The fact that the A. O. Smith method was patented prevented preference being given to it in the Code. The Boiler Code Committee was genuinely interested in the advance of the art. On Sept. 16, 1927, another communication from Mr. Anderson to Chairman Low was before the Committee as well as correspondence between Mr. Low and Prof. J. M. Jasper in charge of research of the A. O. Smith Company regarding the belief that tests in Washington would be of little value to the company.

BOILERS OF LOCOMOTIVES

A proposed hearing on the Rules for Welding of Locomotive Boilers by the Interstate Commerce Commission was announced on Mar. 19, 1927. A set of tentative rules was attached to the notice. The rules and instructions governing the use of fusion welding in the construction and repair of locomotive boilers in so far as new work was concerned followed Par. 186 of the ASME Boiler Code in permitting autogenous welding where the stress was carried by other constructions which conformed to the requirement of the Code and where safety was not dependent upon the strength of the weld.

In answering this notice the Boiler Code Committee on May 20, 1927, commented on the proposed Par. 8 which prohibited welding of door sheets and flue sheets to the crown sheet which was being done to some extent. Par. 13 might permit the welding of rivet heads to the sheets as was desired by some companies, although never approved by the Boiler Code Committee. In general the rules for new work conformed to the requirements of the ASME Power Boiler Code.

During 1927 the Interstate Commerce Commission prepared Rules for Welding on Locomotives under Federal jurisdiction and members of the Subcommittee on Welding were asked for criticisms.

SPECIAL WELDING METHODS

At the meeting of Dec. 2, 1927, E. E. Shanor of the Petroleum Iron Works, Sharon, Pa., outlined the method of arc welding used by his company. This used a small single-V weld with metal laid on in layers, and each one back-stepped. Each layer was thoroughly calked with a pneumatic hammer after cleaning. The last layer was not calked. He explained that the company had developed a coating for wire electrodes, and wires $^3/_8$ in. to $^1/_2$ in. were used with amperage of 400 to 900 amp. The Boiler Code Committee requested Mr. Shanor to submit or suggest procedure for welding pressure vessels to be constructed by this method.

At the same meeting John H. Lawrence of the Thomas E. Murray Company described the welding process used by them. This method, he stated, was applicable to parts used in power-plant work with small steel castings, valves, and fittings. The process was rapid, of the order of 1 second per weld. It had been used for about 10 years by the Metropolitan Engineering Company of Brooklyn. Thomas E. Murray described the details. It was an electric butt-weld resistance process using currents of 150,000 amp per sq in. in place of the ordinary 400 to 500 amp per sq in. of the Thompson method. The process used controls of the current machines to exert pressures to follow the metal during the welding. Welds showed a fine grain under the microscope. The area to be welded had a limit of 40 sq in. F. R. Low pointed out that dies must be made for the object to be welded and that only experienced men could be used. This method was really one of forge welding and should come under that section of the Code.

AMERICAN MARINE STANDARDS COMMITTEE

As noted in the previous chapter, the appointment of a subcommittee of the Boiler Code Committee to co-operate with the American Marine Standards Committee was authorized on May 2, 1924. E. C. Fisher, *chairman*, E. R. Fish, and D. S. Jacobus were appointed at a later date.

The American Marine Standards Committee was sponsored by ex-President Herbert Hoover when he was Secretary of Commerce. Among other assignments it was in charge of the preparation of rules covering the construction and care of marine boilers. At a meeting of its Subcommittee on Rules for Boiler and Pressure Tanks (March 31, 1926), Dickinson N. Hoover, then Supervising Inspector General of the Steamboat Inspection Service, made it clear that the Service wished to adopt rules which would be thoroughly up to date. He suggested that a review be made of all established codes, such as those of the

[1] Member of Boiler Code Committee.

present Rules of the Inspection Service, and those of the Ship Registries, the American Bureau of Shipping, and the ASME Boiler Codes, with the purpose of preparing a set of rules which would include the best of all, and to have these made legal for the use of the Steamboat Inspection Service. To get advice and criticism from members of the Boiler Code Committee, the request for the appointment of a co-operating committee from the Boiler Code was made and accepted.

There are few minutes relating to this subcommittee during this period 1925–1927. The death of the chairman, E. C. Fisher, on May 18, 1925, was noted as well as the appointment of his successor on Sept. 18, 1925, V. M. Frost. H. E. Aldrich and C. W. Obert also were added to the committee. Mr. Frost reported the annual meeting of the American Marine Standards Committee on Jan. 26, 1926, at which the completion and issuance of a Code of Rules for the Care of Scotch Marine Boilers in Service was announced. When, however, the subcommittee told the secretary of the meeting that the ASME Boiler Code Committee had just finished and issued its Rules for the Care of Power Boiler in Service, it was not permitted to announce this at the meeting.

After this meeting, many members of the Board of Steamboat Inspections present were greatly interested in the ASME Boiler Code, and interrogated the subcommittee.

At a meeting of Subcommittee 9-9 of the American Marine Standards Committee (March 17, 1926) for the purpose of recommending a procedure for forming an official unified Boiler Construction Code for Marine Boilers the suggestion was approved of using the rules of the American Bureau of Shipping, as the U. S. Steamboat Inspection Rules were too archaic, the ASME Boiler Code was meant for land boilers, and an entirely new set of rules would cause too much delay. C. W. Obert brought out the fact that the ASME Code could be adjusted to meet marine practice and was more complete. Evidently, the larger group desired the selection made by them.

V. M. Frost announced to the Boiler Code Committee at its meeting on April 30, 1926, that as the result of a request from H. C. E. Meyer of Subcommittee 9-9, the secretary's office had made a comparative table from clippings from the ASME Code, the rules of U. S. Steamboat Inspection Service, and the rules of the American Bureau of Shipping, and had arranged comparable sections on the same line, with those for which there was no counterpart alone in the column for the code from which it was taken. Even this had no effect, and when the final form of Rules for the Construction of Marine Boilers was reported, Dr. Jacobus announced to the Boiler Code Committee at its meeting of Oct. 28, 1927, that in this preparation the ASME Boiler Code had been disregarded, although at the meeting of the American Marine Standards Committee on Mar. 31, 1926, a resolution directed the subcommittee headed by Mr. Meyer to collaborate with the subcommittee from the ASME and with representatives of the ASTM and the American Steel Manufacturers. The rules were those of the American Bureau of Shipping and the Steamboat Inspections Service.

A letter to Dickinson N. Hoover was authorized and sent. This letter pointed out that in consideration of the order to Mr. Meyer on March 21, 1926, the secretary of the Boiler Code Committee had forwarded to Joseph P. Nelis, chairman of Subcommittee 9-9, a comparison of the various rules as well as copies to H. C. E. Meyer for all of the members of his Committee. It also mentioned the fact that it had written to Mr. Nelis with copies to Mr. Bouillon, the secretary, but with no action. The letter made clear that only the Rules of the Steamboat Service and those of the American Bureau of Shipping had been used.

On Nov. 5, 1927, Mr. Hoover replied after his return from the South pointing out that (1) he stood behind his position expressed in March 31, 1926, when he stated he wanted the best in all the codes used in the new one; (2) Mr. Bouillon was simply preparing a code which could be criticized constructively; (3) Mr. Bouillon's sole thought was to get action; (4) in the adoption of a standard the American Marine Standards Committee had authority but that the Board of Supervising Inspection had authority to approve its own rules and (5) his advice relating to the Boiler Code Committee's action would be to make such criticism as it desired of the code prepared by Mr. Bouillon.

HEAVY FORGED DRUMS

The Babcock & Wilcox Company informed the Boiler Code Committee on Oct. 23, 1925, that the Massachusetts Board of Boiler Rules had accepted the use of specification for steel submitted in the report for the fabrication of a very heavy forged drum (5 in. thick) of an internal diameter of 40 in. The steel had a minimum strength of 75,000 psi. It asked the Boiler Code Committee if such steel would be suitable for a steam pressure of 2300 psi. This request was referred to Prof. E. F. Miller of Massachusetts Institute of Technology and Prof. Albert Sauveur of Harvard. On favorable report from these experts the Boiler Code Committee (Nov. 11, 1921) voted to approve the specification submitted for application in a special case not covered by the Code and in no way establishing a precedent for a standard specification.

An application from the Ladd Water Tube Boiler Co. for approval of a similar specification for steel to be used in a solid drum forging to be used with 1200 psi was considered at the meeting of April 30, 1926, and a reply similar to the one given to the Babcock & Wilcox Company was made.

These two cases indicated the need for a specification for seamless-steel drum forgings which was adopted by addenda in 1926 for the 1927 Edition of the Code.

OTHER MATERIALS

The testing of material from long narrow butt straps cut from plates from a universal mill required a test sample to be cut perpendicular to the rolling and the effects of straightening gave improper test results. The 1927 Edition of the Code was so changed as to permit test of such metal in straps to be made in direction of rolling

A specification of a heat-resistant alloy to be used for superheater tubes by the Babcock & Wilcox Company was approved on April 30, 1926, for application in a special case not covered by the Boiler Code and in no way establishing a precedent for a standard specification.

The formulation of a specification for sheet nickel for boilers was referred to the Subcommittee on Material Specifications for conference with the ASTM.

Use of cast-aluminum alloy for miniature boilers was brought to the committee on Sept. 17, 1927, by the Aluminum Industries, Inc., and the applicant was asked for further information.

The subject of seamless steel boiler tubes with noncorrosive properties and the use of Armco Ingot Iron for low-pressure boilers was referred to the Subcommittee on Material Specifications on Sept. 17, 1927.

MISUSE OF CODE SYMBOL

One company which did not prevent the improper use of the stamp was deemed to have been negligent although it did not willfully permit the misuse of the stamp. Another company was asked to return its stamp because of misuse.

The Boiler Code Committee ruled that when a manufacturer who held a symbol disposed of his business by sale or otherwise he must return his symbol and the new owner must execute a new affidavit and secure a new symbol and registration number.

HEARINGS

The only hearing during 1925–1927 besides that mentioned under the Rules for the Care of Boilers in Service was that held for representatives of the American Petroleum Institute which desired changes in Par. P-250 so as to eliminate the necessity of telltale holes in stay bolts of small locomotive-type boilers used in oil fields and in Par. P-194 to permit a dome of diameter greater than 0.6 of the diameter of the shell of such boilers. This hearing was held on Jan. 12, 1927, following a number of refusals of any changes at meetings extending back several months. Those appearing were S. J. Dickey, chairman of the API Boiler Standardization Committee, represented by Dr. R. P. Anderson of the New York office of the API and Prof. R. L. Daugherty of Pasadena, Calif., W. L. Connelly of the Mammouth Oil Company, Casper, Wyo., M. H. Broderick, The Broderick Company, Muncie, Ind., and T. Fleming, Jr., Oil Well Supply Company, Pittsburgh, Pa.

These representatives gave reasons for having oil-country boilers with large drums because of the sudden demand for steam for short intervals. They also stated that the telltale holes in stay bolts were of no value and became clogged with scale when small cracks occurred before rupture. They produced many confirming letters. Some letters, however, from the users of these boilers showed a desire for such holes and A. G. Pack, chief inspector of the Interstate Commerce Commission, a conference member of the Subcommittee on Boilers of Locomotives, described the need of such holes based on his experience over many years.

After this hearing the Boiler Code Committee appointed a subcommittee of Messrs. Jeter, Jacobus, and Fish to consider the form of a revision of Par. P-194 to allow an increase in diameter of the dome with the requirements for staying of the shell underneath the dome, considering the method of reinforcing and staying prescribed in the Canadian Interprovincial Boiler Regulations for neutral sheets under boiler domes. It also directed the subcommittee to consider revisions of Par. P-200 which would place the required telltale hole exemption on a more rational basis.

MISCELLANEOUS ACTIVITIES

Requests for a decision on what was the lowest safe water level for the locations of the fusible plugs from manufacturers of different types of hot-water boilers were numerous, and the Boiler Code Committee decided that there should be no ruling to suit every case and that the statements in Section IV should stand. Each special design must meet the requirements of the inspector.

The Subcommittee on Material Specifications recommended for approval (Sept. 24, 1926) the following specifications of the American Society for Testing Materials in place of the modified forms used in the 1924 Code: Lap Welded and Seamless Steel and Lap Welded Iron Boiler Tubes (A83-24), Welded and Seamless Steel Pipe (A53-21), Welded Wrought Iron Pipe (A72-24), Copper Pipe (B42-24), Brass Pipe (B43-), Carbon Steel Castings for Valves, Flanges and Fittings for High-Temperature Service (A95-26T), Carbon-Steel and Alloy-Steel Forgings (A18-24).

DISHED HEADS

Requirements for dished heads and their amendments were brought to the attention of the Boiler Code Committee by a paper, "The Design of Dished Heads of Pressure Vessels," by S. W. Miller, in MECHANICAL ENGINEERING, August, 1926, and by four papers read before a joint meeting of the ASME Metropolitan Section and the American Welding Society on Jan. 4, 1927. These were: "Examination of the Ruptured Head of the Ethylene Tank," by S. W. Miller; "Oxyacetylene-Welded Construction of Large High-Pressure Storage Tanks," by H. E. Rockefeller; "Stresses in a Large Welded Tank Subject to Repeated High-Test Pressures," by T. W. Greene; and "The Design of Dished and Flanged Pressure-Vessel Heads," by A. B. Kinzel.

Because of the importance of the papers and because the time for discussion had been limited, H. LeRoy Whitman suggested that the Boiler Code Committee plan a special meeting or hearing under the auspices of the Boiler Code Committee so as to have the information in these papers discussed and considered. Such a meeting was called for the evening of Feb. 17, 1927, and before the Committee meeting of Feb. 18, 1927. The secretary was directed to send copies of the papers to Committee members and to those of the boiler industry who were notified. The papers of Messrs. Miller, Greene, and Kinzel appeared in the August, 1926, issue of MECHANICAL ENGINEERING and that of Mr. Rockefeller in the May issue.

The meeting was attended by almost 50 persons who asked questions of the authors and made constructive suggestions. As a result, a special committee consisting of D. S. Jacobus, E. R. Fish, and S. F. Jeter was appointed to consider the minutes of the meeting (published in MECHANICAL ENGINEERING, June, 1927, pp. 637–644) and report with special reference to modifications or revision of the rules in the Code for the design of dished heads.

COLD FLANGING

The formulated reply given to the Communication (Item 1394) from the Stanwood Corporation of Cincinnati, Ohio, regarding cold flanging stated in conclusion "that while the Committee has insufficient data available to formulate a comprehensive rule covering the practice of cold flanging of plates, it is the opinion that where furnace sheets and cylindrical heads are satisfactorily formed by cold flanging of boiler plates, they may be used with safe results provided they are properly annealed." Criticism of this reply caused its withdrawal and the appointment of a committee to consider the matter and report. The committee, Charles L. Huston, *chairman*, H. E. Aldrich, C. E. Bronson, E. R. Fish, Wm. F. Kiesel, Jr., and A. G. Pack, reported on May 20, 1927, giving five requirements for cold flanging based on a very thorough investigation and a number of practical tests. These five requirements relate to: (1) Use of Code materials with a knuckle radius of not less than three times the thickness for straight sheets; (2) the same in heads having circular or curved outline not less than 50 times the plate thickness; (3) the same in plates, the edges of which have flanged portions of circles or curves; (4) over-all depth of flange on circular heads and similar curved edged plates should not exceed ten times the thickness, counting in plate thickness, knuckle radius, and flange; and (5) normalizing or annealed at not less than 1200 F. The reply was then drawn to include these requirements.

MASSACHUSETTS BOARD OF BOILER RULES

On April 15, 1927, Charles E. Gorton reported that a conference should be held between a special committee of Messrs. Low, Jacobus, and Moultrop, appointed in 1921 to confer with the Massachusetts Board of Boiler Rules and its conference committee to consider the two present major differences between the Massachusetts Rules and the ASME Code and also the possible adoption of the Low Pressure Heating Boiler Section by the State. The Boiler Code Committee requested the Special Committee to arrange such a meeting to consider these matters. On May 20, 1927, Messrs. Clark and Jeter were appointed to replace Mr. Low, and Dr. Jacobus was appointed chairman.

MACH-ZEHNDER INTERFEROMETER APPLICATIONS

As Used in the Study of Convection and Conduction Heat-Transfer Systems

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Introduction

THE Mach-Zehnder interferometer, Fig. 1, is ideally suited to the study of many two-dimensional convection and conduction heat-transfer systems. The experimental techniques required of this type of application have not been developed fully, nor have the possibilities of this application been explored thoroughly. In part, this may be due to the initial cost of the instrument and because many of the interferometers which have been built, have been designed around aerodynamic applications and, once set up for this purpose, have not been considered for heat-transfer studies.

The principle of operation of the instrument is based on the phenomenon of light interference and the change of refractive index with fluid density. A beam of collimated light is divided by a half-silvered mirror, Fig. 2. The two resulting beams of light travel different paths within the instrument and are recombined at a second half-silvered mirror. One of the beams of light passes through a test section where models may be inserted. Considering an application to heat transfer from a heated cylinder, the beam of light which passes through the test section is modified as a result of the increase in velocity of the light in the less dense air surrounding the heated model. Therefore, when this beam is recombined with the second beam which passes through the instrument undisturbed, the parts of the beam which pass through the heated air are out of phase with corresponding parts of the undisturbed beam. When these beams are projected on a screen, there are light and dark areas in the picture depending on whether the optical path lengths through the instrument differ by an even or odd number of half wave lengths. The resulting interference pattern, Fig. 3, may be evaluated quantitatively to determine the density distribution in the air surrounding the model. In a similar manner the density fields surrounding wind-tunnel models may be evaluated to find pressure distributions over aerodynamic shapes.

In a flow field where the pressure changes are negligible and the air-density changes result from temperature changes, such as in the air surrounding a heated object in free convection, the temperature gradients at the heated surface may be evaluated to determine the rate of heat flow by convection. One of the earliest applications of the interferometer to this type of study was by R. B. Kennard in 1931 (1),[1] in his study of free convection from vertical flat plates and horizontal cylinders. Similar investigations have since been made by E. Eckert, E. Soehngen, and others. To date, however, the applications of the interferometer to heat-transfer studies have been relatively few in number compared to the aerodynamic applications.

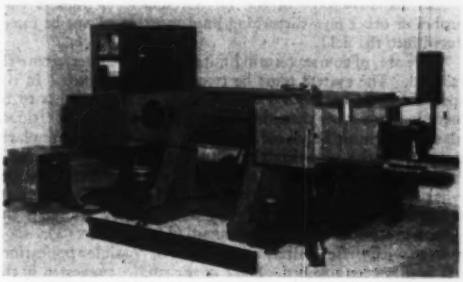

FIG. 1 THE MACH-ZEHNDER INTERFEROMETER

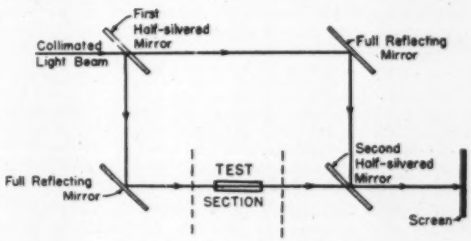

FIG. 2 BASIC OPTICAL SYSTEM

In order to encourage the wider use of the interferometer in the field of heat transfer, several novel applications of the instrument have been investigated which would utilize more fully its unique advantages as a temperature-measuring device. Before considering the applications, a review of these unique features of the interferometer would be appropriate.

The interferogram, which is the photographic record of the interference pattern, provides an instantaneous picture of the entire temperature or density field surrounding a two-dimensional model. This allows the evaluation of the temperature gradients at the surface of the model, from which the convection heat transfer is determined. Moreover, the temperature of the model surface itself is indicated by the air temperature adjacent to it. Where steep temperature gradients exist within

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Heat Transfer Division and presented at the Annual Meeting, New York, N. Y., November 30-December 5, 1952, of The American Society of Mechanical Engineers.

the model, the accurate measurement of surface temperatures with thermocouples is a severe problem.

The instantaneous response of the interferometer to temperature change is limited only by the speed of the recording technique. Photographs of the interference patterns may be made with exposures of a few microseconds, using a spark-discharge light source, or moving pictures of changing patterns may be obtained readily at speeds from 16 frames per sec, to 3000 frames per sec. Pictures taken at the latter speed are included in this paper. This feature of the interferometer makes it invaluable for the study of transient phenomena.

The interferometer pattern renders visible the flow field surrounding a heated object. Although the velocity field is not revealed directly, methods of evaluating it may be developed. At high fluid velocities, the pressure field may be used to evaluate the velocity field. A free-convection velocity field may be studied by the superposition of a known velocity or by introducing disturbances into the flow field.

Another advantage of the interferometric method is that probes or other flow-disturbing implements need not be introduced into the field.

There are, of course, certain limitations to the interferometric method. The system must be two-dimensional except in the special case of axially symmetric flow. If the study is to be made in fluids other than air at atmospheric pressure, additional glass plates must be placed in the light paths and these plates must be of the same high quality and accuracy as the basic interferometer plates. The area of study or model size is somewhat limited by the size of the field of view of the instrument. However, this difficulty may be overcome by studying the system in sections as done by Kennard (1) and Eckert (2).

Even with these limitations, the field of possible applications has hardly been touched. Some of the studies suggested in the following portion of this paper have been investigated by other methods, but it is felt that the interferometer will provide information about the systems not previously obtainable. It is hoped that the studies discussed here will suggest additional applications not heretofore considered.

Description of Interferometer

The Mach-Zehnder interferometer used in these studies was designed and built at the University of California, Los Angeles, to provide a general laboratory instrument to be used in the visualization and evaluation of fluid-density fields in both heat-transfer and aerodynamic studies. The useful field of view of this interferometer is an ellipse 9 in. $\times$ 5½ in.

To provide for vertical or horizontal flow fields and for utilization with an existing 3-in. supersonic wind tunnel, the frame housing the optical components may be rotated through 90 deg about its horizontal axis. Several different light sources and cameras are available, including an Eastman high-speed camera.

Evaluation of Interferogram

The theory of interference fringes and the derivation of equations used in evaluating the interferograms are presented in most of the references in the Bibliography. For the purposes of this paper a brief summary of the relations used will suffice.

The type of interference pattern used for a particular study may be varied by proper adjustment of the optical system. The undisturbed field of interference fringes may be adjusted to any desired fringe spacing or direction. The width of the fringes may be increased until one fringe covers the entire field of view. This is referred to as the adjustment for infinite fringe width.

Temperature distributions are determined from the interferograms by measuring the fringe shifts. The fringe shift at a point in an interferogram is the change in optical path length in wave lengths of light through that part of the field due to the disturbance in the test section. If the interferometer has been adjusted for infinite fringe width, the fringes appearing in the field are lines of constant phase change or isodensity lines, Fig. 3. The fringe shift is the number of fringes counted from the undisturbed or reference field. If the reference field is bright, then the first bright fringe is a shift of one.

When the interferometer has been adjusted for a fringe field,

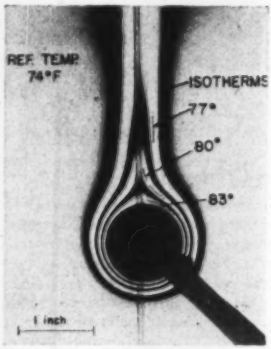

FIG. 3 INTERFEROGRAM FOR HEATED CYLINDER IN FREE CONVECTION

Fig. 4, the fringe shift at a point is the displacement of the fringe through that point from its undisturbed position, expressed as the displacement divided by the spacing of the undisturbed fringes.

Temperatures are evaluated using the following equation which relates the fluid temperature change ΔT to the fringe

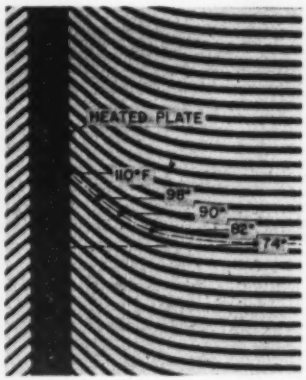

FIG. 4 FRINGE FIELD NEAR SURFACE OF HEATED VERTICAL PLATE

shift ΔN, length of the model L, wavelength of light λ, refractive index for air n, and the reference temperature T_r:

$$\Delta T = \frac{T_r \Delta N}{\frac{L}{\lambda}(n-1) - \Delta N} \quad \ldots\ldots\ldots\ldots [1]$$

The interferogram resulting from the infinite fringe-width adjustment gives a direct graphic plot of the temperature distribution throughout a two-dimensional field. In the typical case of the heated cylinder in Fig. 3, the thickness of the ther-

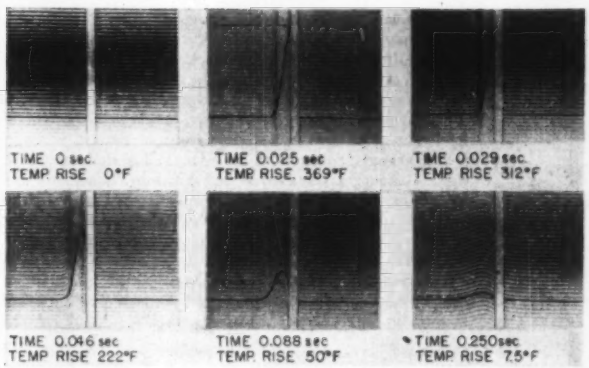

FIG. 5 INTERFEROGRAMS FOR PLATE HEATED BY A NO. 50 FLASH BULB

mal boundary layer, the direction of the flow field, and the temperature gradients at the cylinder surface may be obtained readily. Such a picture is an excellent visual aid in studying the nature of heat flow by convection.

In the case of a vertical plate, with the fringes oriented perpendicular to the surface, each fringe is, in effect, a plot of the temperature distribution in the air adjacent to the plate. The plate surface temperature is indicated by the displacement of the fringe where it intersects the plate surface, and the slope of the fringe at the plate surface is related directly to the rate of heat loss from the surface by convection. This makes it possible to evaluate conductances for surface temperatures which may be a function of distance along the plate or a function of time.

The fluid velocity at the surface of an object in a convection field is zero; therefore, the heat from the surface is transmitted to the first layer of the fluid by conduction, so that the heat flow may be described by the conduction equation

$$\frac{q}{A} = -K\frac{dT}{dx} \quad \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

The value of the temperature gradient at the surface may be obtained from the evaluation of the interferogram. The value of the thermal conductivity of the fluid is taken at the surface temperature.

The heat loss from a surface by convection is usually expressed by the relation

$$\frac{q}{A} = h_c(T_s - T_r) \quad \ldots\ldots\ldots\ldots\ldots\ldots [3]$$

where h_c is the unit thermal conductance. Thus the interferogram may be used to determine local values of the conductance, since at each point on the surface, the quantity q/A, and the temperatures may be evaluated. Published data on convection conductances are correlated on the basis of Nusselt's modulus Nu, which may be evaluated readily from the interferogram by the equation

$$\mathrm{Nu} = \frac{D}{(T_s - T_r)}\frac{dT}{dx} \quad \ldots\ldots\ldots\ldots\ldots\ldots [4]$$

STUDY OF TRANSIENT HEATING OF A FLAT PLATE

One of the shortcomings of thermocouples and recording oscillographs is their relatively slow response time. Consider the problem of determining the surface temperature rise of a flat plate exposed to a short-time radiant source such as a photoflash bulb. An analytical approximation to the temperature-time history of the surface of the plate shows that the temperature will rise to a maximum temperature in about the same length of time that the flash bulb reaches its peak, which is about 0.025 sec, after which time the surface temperature drops rapidly due to diffusion of heat into the plate. Under such circumstances, the temperature gradients within the plate are very high, and the determination of the temperature exactly at the surface of the plate as a function of time would pose quite a problem if thermocouples were used.

The application of the interferometer and the high-speed camera to this problem is illustrated in Fig. 5. These pictures are enlarged stills from a reel of 16-mm movie film taken at 3000 frames per sec. The setup was a $^1/_{16}$-in-thick stainless-steel plate blackened with carbon soot and heated by means of a No. 50 photoflash bulb set off $2^1/_2$ in. from the surface. The fringes were adjusted perpendicular to the plate surface and spaced about 40 fringes per in. A portion of the field of view $1^1/_2 \times 2$ in., was brought to focus on the film in the Eastman high-speed-camera.

One of the problems in this particular application was caused by the refraction of light in the heated layer of air adjacent to the plate. Since the heating was transient, there was no opportunity to refocus the fringes that were blurred by the refraction. Although the fringes were lost in the high temperature gradient, the fringe shift could be approximated by matching up the gradients across the blurred region.

A plot of the luminous output of the No. 50 flash bulb and the temperature of the plate surface as a function of time are shown in Fig. 6. The circled points are the temperatures determined from the photographs.

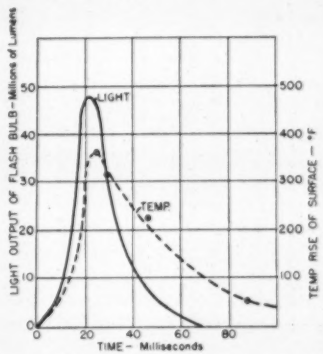

FIG. 6 TEMPERATURE RESPONSE OF PLATE HEATED BY FLASH BULB

The interferograms also show that the temperature of the back surface of the plate does not rise a measurable amount until approximately 0.10 sec after the start of heating. The temperature distribution in the air at the front surface indicates the rate of heat diffusion into the air and the reverse flow of heat from the air back into the plate as the plate surface cools faster than the adjacent air.

STUDY OF HEAT FLOW IN COMPOSITE TWO-DIMENSIONAL MODELS

The ability of the interferometer to provide an instantaneous picture of an entire temperature field including model surface temperatures makes possible the evaluation of heat flow within the model in addition to the heat flow from the model into the air. Applications of this type are illustrated in Figs. 7, 8, and 9.

In Figs. 7 and 8, the models are joints fabricated from aluminum sheets with riveted connections. To obtain a high rate of heat flow through the metal joint, the upper part of each model

FIG. 7 TEMPERATURE FIELD SURROUNDING RIVETED ANGLE JOINT

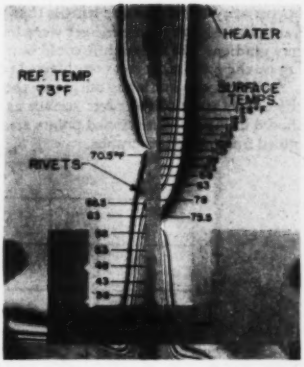

FIG. 8 TEMPERATURE FIELD SURROUNDING RIVETED LAP JOINT

was heated with an electrical-resistance heater while the lower end of the model was immersed in a dry ice-alcohol bath. The heat input to the upper end of the model was adjusted so that the center of the joint itself was as close as possible to room temperature. This proved to be an effective method of insulating the joint from heat losses.

From the interferograms, the temperature distribution along the model was determined. The rate of heat flow in the metal into and out of the joints could then be evaluated from the temperature gradients along the plates. The heat loss or gain of the joint by convection also was obtained from the interferograms. In Fig. 8, the rate of heat flow through the joint is 122 Btu per hr, while the rate of heat loss from the side of the joint is less than 1.5 Btu per hr.

Knowing the temperature distribution in each of the sheets forming the joint, it is possible to evaluate the thermal contact resistance for this type of riveted joint. Work on this particular problem, using the interferometer is still in progress.

Fig. 9 illustrates the flow of heat within a cellular wall such as found in house construction. The model is fabricated from two aluminum sheets spaced $^3/_4$ in. apart. One side of the wall is heated radiantly with a flood lamp. As the heated side of the wall rises in temperature, a circulating air pattern is set up within the wall to transfer heat from the hot side to the cool side. The temperature distribution shown by the set of white-light fringes demonstrates that a circulating pattern exists because the temperature gradient through the wall at the center is zero, while heat is flowing into the air at the hot side of the wall and from the air into the metal at the cool side of the wall. This type of model may be used as a teaching aid in visualizing heat flow in complex systems, as well as providing a method of obtaining basic heat-transfer data.

STUDY OF COMBINED FREE AND FORCED CONVECTION FROM CYLINDERS

The published data and equations used for predicting the rate of heat transfer from a heated horizontal cylinder in forced convection do not apply at very low velocities in air when the effect of free-convection velocities becomes important. Furthermore, if the heat transfer to the air from the cylinder by free convection is predicted from the following equation as presented in reference (3), it is found to correspond to the heat loss for some finite forced-convection velocity

$$Nu = 0.468\ Gr^{1/4} \text{ for } 10^3 < Gr < 10^7$$

where

Nu = Nusselt's modulus
Gr = Grashof's modulus

Therefore, the experimental curve for forced-convection conductances presented in Fig. 10, cannot be applied unless it is

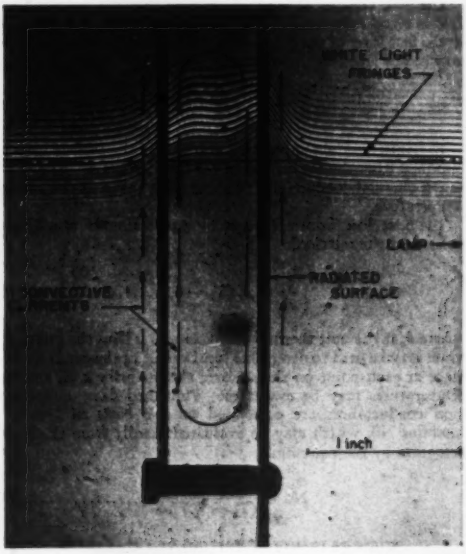

FIG. 9 TEMPERATURE DISTRIBUTION THROUGH WALL CELL HEATED BY RADIATION ON ONE SIDE

known that the component of free convection is negligible. It is recommended by McAdams (4) for the case of convection at low velocities, that both the free and the forced-convection heat losses be predicted and the higher value be used. This procedure would result in the dashed portion of the curve in Fig. 10, which has been drawn in for the case of a 1-in-diam cylinder at a Gr = 30,000. If the Grashof's modulus were increased, the dashed line would be raised and intersect the forced-convection curves at higher values of Reynolds modulus. There do not seem to be any data to justify this procedure for the case of large cylinders, nor is there any information on the mechanism of the transition from free to forced-convection air flow.

For the case of small-diameter cylinders or wires, however, the problem of combined free and forced convection has been considered in more detail (5). It was found for the thermocouple anemometer, whose calibration is dependent upon the rate of heat loss from a heated length of wire as a function of wind velocity, that at velocities of the order of 2 or 3 fpm, the heat loss actually was less than that for free convection. The explanation offered for this phenomenon is based on the change in the flow field past the wire as a horizontal velocity component is superimposed upon the vertical free-convection pattern.

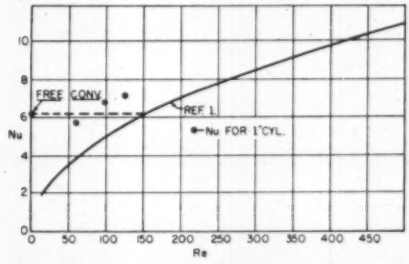

FIG. 10 AVERAGE VALUES OF NU FOR A HORIZONTAL CYLINDER IN CROSSFLOW VERSUS RE
(Free convection Nu at Gr = 30,000.)

With the interferometer, the transition in the flow field about the cylinder may be observed visually and studied in detail. The relative magnitudes of the free and forced-convection velocities may be seen from the form of the flow patterns set up, Figs. 11 and 12. The lack of published data for the heat transfer from any size of cylinder in the region of the transition from free to forced convection provides an extensive field of investigation by the interferometric method.

The existing equipment set up for this study consists of a number of electrically heated cylinders which may be mounted on a motor-driven arm that moves through an arc of 35 in. radius in still air at a specified velocity. The moving cylinder is located inside a draft-free enclosure which surrounds the test section of the interferometer. Controls are provided so that the movement of the cylinder may be controlled remotely by the operator from the position of the interferometer camera. The solenoid-operated camera shutter is synchronized with the position of the cylinder so that a picture is taken when the cylinder is in the middle of the field of view of the interferometer. The velocity of the cylinder is determined from the measured time it takes the arm to travel through a specified angular arc.

Analysis of the Data. With the existing equipment, interferograms may be obtained for a heated cylinder at velocities ranging from 2 to 30, fpm, and at cylinder temperatures from room temperature to 200 F. To facilitate the evaluation of the

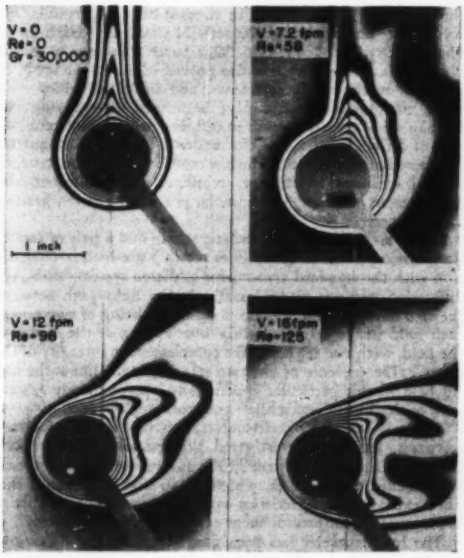

FIG. 11 HEATED 1-IN-DIAM CYLINDER, SHOWING TRANSITION FROM FREE TO FORCED CONVECTION

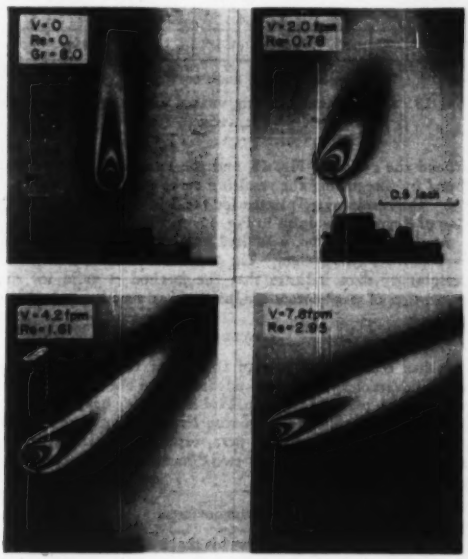

FIG. 12 HEATED 0.046 IN-DIAM CYLINDER SHOWING TRANSITION FROM FREE TO FORCED CONVECTION

temperature distributions and to better visualize the flow field, the interferometer is adjusted for infinite-fringe width. The resulting interferograms for a 1-in-diam and for a 0.046-in-diam cylinder are shown in Figs. 11 and 12. The relative magnitudes of the free and forced-convection velocities are indicated clearly as well as the occurrence of separation at the higher Reynolds numbers.

The quantitative evaluation of the average Nusselt's modulus for the 1-in. cylinder may be described briefly by the following steps:

1 The fringe shift as a function of distance from the cylinder was measured on the interferograms for a number of angles around the cylinder so that a curve of Nusselt's modulus as a function of angle could be plotted.

2 The temperatures corresponding to the fringe shifts were determined from Equation [1], and plotted as a function of radial distance from the cylinder surface on a semi-log graph, the distances being corrected for photographic scale factor.

3 From the curves of temperature versus radial distance, the value of the temperature gradients, dT/dx, at the surface of the cylinder were found by drawing in the slope of the curve at $x = 0$.

4 The value of Nu for each angle was determined from Equation [4].

5 Nusselt's modulus was plotted as a function of angle

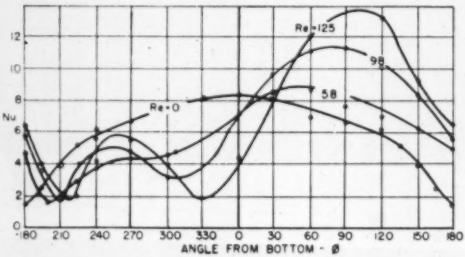

FIG. 13 LOCAL VALUES OF NU VERSUS ANGULAR POSITION ON CYLINDER

around the cylinder, Fig. 13, and the integrated average was found by integrating the resulting curve graphically.

6 The results were plotted for the 1-in. cylinder as a function of Reynolds modulus in Fig. 10.

At the present time, a limited number of points have been evaluated for this system. The conclusions drawn from these preliminary data indicate that the method is valid for the evaluation of steady-state conductances at very low velocities.

CONCLUSION

It has been the purpose of this paper to demonstrate by several examples, the unique advantages of the interferometer as a research tool and as a visual aid in studying heat-flow problems. It is felt that the interferometer has many more possible applications than presented here, especially in the study of transients and more complex two-dimensional convection systems.

ACKNOWLEDGMENTS

The author wishes to express his gratitude to the members of the staff, and student body of the Engineering Department of the University of California, Los Angeles, who assisted in the experimental phases of this work.

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Interferometry

INTERFEROMETRIC methods have proved of particular interest in the study of aerodynamic flow and are finding other applications as extensions of earlier work in such fields as the study of metals, surface polish, hardness testing, and the formation of slip bands in stressed metallic crystals, according to an article by Kenneth Shaftan, in "High-Speed Photography," Vol. 4, 1952. This latter technique of multiple-beam interferometry has also proved of use in the study of thin-film thickness measurements, and indicates utility as a stage micrometer. It has also been used in studying the mechanism of crystal growth in certain minerals, the examination of defects in mica, and the modes of oscillation of quartz.

In aerodynamic investigations, a modification of the standard Ronchi schlieren two-mirror technique has resulted in the development of a new, low-cost, large field diffraction grating interferometer.

In this system, a monochromatic source and a pair of replica transmission gratings (2000 lines per in.) are used in conjunction with the standard two-mirror schlieren system, with the diffraction gratings placed axially in the light path between the two mirrors. Interference fringes consisting of two sets in each field image result, slightly overlapping at the center of the field, with one set being the complement in intensity of the other. The presence of the two sets of fringes limits the useful field in this particular apparatus to approximately 1/3 the area of the 18-in-diam schlieren mirrors employed.

A Mach-Zehnder interferometer, modified for photoelastic purposes, has been investigated theoretically by the Naval Research Laboratory for use in the analysis of residual stresses in quenched glass objects, which are so highly quenched that their explosive characteristics would prevent the use of cutting techniques for the measurement of these stresses.

The interferometer has been used at the Ballistic Research Laboratories at Aberdeen Proving Grounds, Md., in the study of approximately axisymmetric flow at various Mach numbers about a cone-cylinder in free flight.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Bridges

SOME interesting facts about bridges and bridge construction in the United States are given in an article by D. B. Steinman in the October, 1952, issue of *The Scientific Monthly*. For example, Mr. Steinman points out that during the nineteenth century, the principal demand for bridge construction in the United States was in the building and development of the railroads. At the turn of the century, many of the railroad bridges were being replaced or reconstructed to provide increased strength and clearance for the rapidly increasing size, weight, and clearance of the trains and locomotives. Even thereafter, railroad extension involved the building of such monumental spans as the Hell Gate Arch and the Sciotoville continuous bridge.

Since about 1920, however, there has been no further extension of the rail systems, and the economic plight of the railroads has limited the improvement of existing construction, Mr. Steinman notes. Instead, the phenomenal increase in highway traffic has created a new phase of bridge construction in which there are both the economic justification for bridges of unprecedented dimensions over crossings that previously had to be left unspanned and the need for myriads of smaller bridges and grade-separation layouts.

There are more than 90,000 steel bridges on 240,000 miles of railroad in the United States, and the total length of these is more than 1500 miles. But the number of highway bridges, both steel and concrete, in the United States probably exceeds 250,000 on the 3,000,000 miles of roads and highways. The total investment in these highway bridges amounts to over $3,000,000,000.

Cities located at junctions of rivers are particularly dependent upon bridges for their development, and thereafter for mobility of their population. The city of Pittsburgh has 16 highway bridges, and seven railroad bridges spanning the Allegheny and Monongahela rivers. In New York City, in a single day, more than 750,000 automobiles and trucks cross the highway bridges entering Manhattan—450,000 on 12 free bridges (including 90,000 on the Queensboro Bridge and 80,000 on the Manhattan Bridge), and 300,000 on three toll bridges (George Washington, Triborough, and Henry Hudson)—besides more than 700,000 passengers daily on rapid-transit trains and electric trolley cars.

Individual bridges, Mr. Steinman states, have proved of tremendous importance as the key factors in the development of cities, regions, and the nation as a whole. The Eads Bridge over the Mississippi River at St. Louis, completed in 1874, was the essential link in the development of the transcontinental railroad system, and its significance in "the winning of the West" has been well recognized. At the same time, the Eads Bridge was of prime importance to St. Louis, establishing it as a focal railroad crossing and as one of the most important cities on the Mississippi. The influence of the construction of a bridge on the transportation pattern of a region or of the nation, affecting its population, industry, and commerce, has been repeated many times over the whole length and breadth of the land.

Probably no bridge has had more influence on the growth of a city than the Brooklyn Bridge, completed in 1883. The population of Brooklyn was soon doubled, and the erstwhile village became a thriving city and an integral part of the newly formed city of greater New York. The three additional East River bridges, which had to be built in quick succession, completed the transformation of Brooklyn into the largest borough of the enlarged metropolis and the creation of the great new borough of Queens.

The seven longest spans in the world are in the United States: Golden Gate, 4200 ft; George Washington, 3500 ft; Tacoma Narrows, 2800 ft; Transbay, 2310 ft; Bronx-Whitestone, 2300 ft; Delaware Memorial at Wilmington, 2150 ft; Detroit-Ambassador Bridge, 1850 ft. All these are of the suspension type and all are highway toll bridges.

The largest bridge project in the world consummated to date is the Transbay Bridge between San Francisco and Oakland, completed in 1936 at a cost of over $77,000,000. Its total length of eight miles includes two joined suspension bridges of 2310 ft main span each, a cantilever bridge of 1400 ft main span, and other connecting spans. A record foundation depth of 240 ft was reached for one of the piers.

The world's longest span is the Golden Gate Bridge, also at

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

San Francisco, completed in 1937 at a cost of $35,000,000. The main span, 220 ft above the water, is 4200 ft between towers 746 ft high. The two main cables are 36½ in. in diam, the largest constructed to date.

The George Washington Bridge, over the Hudson River at New York, with a main span of 3500 ft, was opened in 1931 at an initial cost of $60,000,000. It has four main cables, each 36 in. in diam. The present deck carries eight lanes of highway traffic, and provision has been made for the addition of a lower deck.

With wider and more numerous crossings required, Mr. Steinman states that the bridgebuilders of the U. S. and Canada have achieved and retained world leadership in almost every modern type of bridge, including not only the unrivaled suspension bridges, but also the world's longest spans in cantilevers, steel arches, continuous trusses, simple trusses, timber spans, swing spans, vertical-lift spans, bascule spans, and transporter bridges. American engineers have also pioneered in inventing or developing new types, including movable bridges, rigid frames, the Wichert truss, and prestressed concrete bridges. About the only types in which European engineers have established new records are concrete arches, prestressed concrete spans, and steel-girder spans; the difference of emphasis and development are explained by differences in tradition (the masonry arch), differences in economics (scarcity of steel), and differences in design preferences and fabrication customs.

Bridges of still greater span length and magnitude than some of the foregoing are already in the planning stage, Mr. Steinman reveals. He has, in fact, designed bridges for proposed locations over the Narrows at New York and over the Strait of Messina in Italy with spans of 4620 and 5000 ft, respectively. A generation ago the feasibility of a span of 3000 ft was seriously questioned. Now, he reports, it can be stated with confidence that suspension-bridge spans up to 10,000 ft are not only practicable, but may be expected.

Ductile-Iron Uses

TO acquaint designers, engineers, and manufacturers with the progress made with ductile iron since its discovery about three years ago, the International Nickel Company, Inc., staged a special ductile-iron demonstration for the technical press on September 25, at its Bayonne Research Laboratory.

During the demonstration, an opportunity was afforded to see the pouring of ductile iron and the laboratory testing of specimens, as well as finished castings. In many cases the castings were shown as parts of actual equipment.

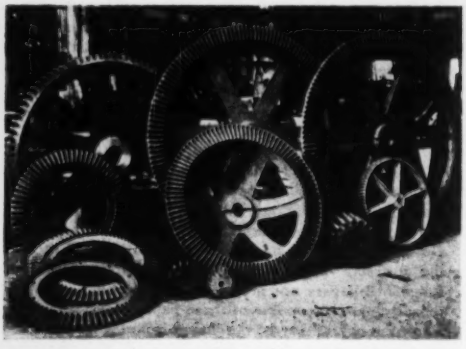


FIG. 1 ASSORTED DUCTILE-IRON GEARS

PROPERTIES

Ductile iron, Inco engineers said, has all the casting advantages of gray iron, with a better combination of strength and ductility than malleable iron. The graphite in its structure is spheroidal in shape. Its production differs from gray cast iron in that a small amount of magnesium is introduced to the molten metal before pouring. It is ductile even in the as-cast condition. This ductility can be greatly increased by simple heat-treatment of about 8 hours or less. It can be cast in sections of all sizes and weights from a few ounces to many tons.

Gray cast iron, because its graphite is in the form of flakes which form a multitude of notches and discontinuities in the metallic matrix, is a relatively weak and brittle material. Compacting the graphite in the form of spheroids reduces internal notching to a minimum and greatly increases the proportion of effective matrix structure.

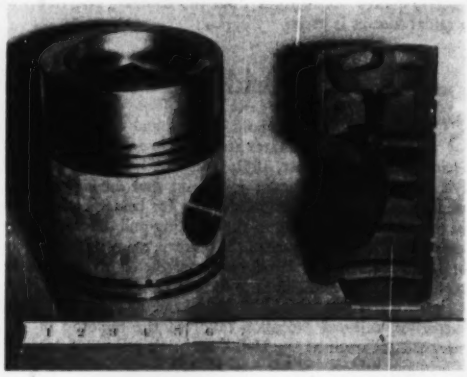


FIG. 2 DUCTILE-IRON DIESEL-ENGINE PISTONS

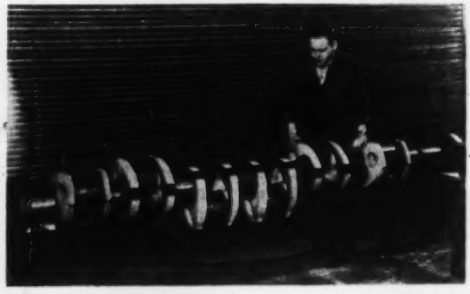


FIG. 3 DUCTILE-IRON CRANKSHAFT FOR DIESEL ENGINE

Bridging the gap between ordinary gray iron and cast steel, ductile iron is being found the end goal of a search foundrymen have been making for generations. Its outstanding strength as well as ductility, in addition to exceptional resistance to shock, is especially useful throughout the industrial world. Automotive, agricultural implement, machinery, petroleum, railroad, and scores of other industries are applying it to hundreds of uses.

FIG. 4 DUCTILE-IRON CASINGS AND IMPELLER FOR CHEMICAL-INDUSTRY PUMP

The following two actual tests made during the demonstration give some idea of the physical properties of ductile iron:

TABLE 1 TENSILE TEST OF DUCTILE IRON

(0.505-in-diam specimen)

	Ultimate strength, psi	Elongation, per cent	Brinell hardness number
As-cast	105,000	8.0	225
Heat-treated	130,000	7.0	275

TABLE 2 TRANSVERSE TEST

(1.2-in. bar, 12-in. span)

	Load, lb	Deflection, in.
High-strength gray iron	3,530	0.147
Ductile-iron	10,215	0.432

Other properties outlined by Inco engineers were as follows: Castability, excellent; machinability, very good; modulus of elasticity, 25,000,000 psi; tensile strength, 60,000–200,000 psi; yield strength, 45,000–150,000 psi; elongation, 1–30 per cent; and hardness, 125–550 Bhn.

Special tests were also devised demonstrating that this new material can be bent, twisted, and otherwise deformed without fracture.

More detailed technical information may be found in an article, "The Industrial Status of Ductile Iron," by A. P. Gagnebin, published in MECHANICAL ENGINEERING, February, 1951, pages 101–108.

APPLICATIONS

An example of one of the best uses of the new material is for producing complex shapes to high mechanical properties. There are many parts of modern machinery which are too intricate to be cast in steel and which have inadequate mechanical properties when cast in gray iron.

Experimental work with ductile iron indicates that advanced designs of compressors, for instance, which have lain dormant for several years because engineering design had outstripped the founding characteristics of available materials, can now be successfully produced in this material.

Another new product made possible by utilizing the fluidity and the high mechanical properties of ductile iron is pipe for city water and other lines. Pipe, 8 in. in diameter, 18 ft long, with a wall section of 0.42 in. was cast as readily in ductile iron as in gray iron.

Gray-iron pipe failed hydrostatically at a pressure of 2400 psi and shattered into a large number of pieces when it burst. Ductile-iron pipe expanded under pressure and developed a pronounced bulge in one zone. Failure finally occurred at a pressure of 5300 psi in the form of a longitudinal crack along the bulge and with no shattering. It is probable that use of ductile-iron pipe now will be permitted for the transmission of fluids and gases now barred to gray iron because of lack of ductility.

Pressure castings, in general, regardless of their intricacy, offer possibilities for ductile iron because, if properly fed, there is no doubt of their pressure tightness. The spheroidal shape of the graphite precludes leakage which often occurs in properly fed gray iron because of the interconnections between the coarse flakes of graphite.

A large and obvious area of application for ductile iron is in castings requiring moderate impact resistance, where gray-iron parts tend to fail because of shock loads in normal service. The inconvenience resulting from such failures in the field is not only costly but also damages the prestige of the equipment manufacturer. Many component parts on agricultural, road maintenance, and earth-moving equipment are in this category.

Some engineers believe that a toughness level represented by 5.0 per cent elongation would prevent the impact failure of many of these castings under normal service conditions. Ductile iron in certain compositions can readily achieve this degree of ductility in the as-cast condition.

Crankshafts provide another interesting market now largely served by steel.

PRODUCTION

Production of ductile iron jumped to above 50,000 melt tons in the United States and Canada in 1951. The foundry industry also noted appropriations of several million dollars to increase facilities for the production of the material by licensees. These tonnage figures compare with approximately 3500 melt tons in 1949—the first year of commercial production—and with approximately 20,000 tons in 1950.

For 1952, production of 80,000 to 100,000 melt tons is expected—an increase of 50 to 100 per cent over 1951. Diversion of materials, including nickel and magnesium, essential

FIG. 5 DUCTILE-IRON PUMP CASING

(This pump replaces one formerly made of steel. It regularly operates without leakage at pressures up to 1500 psi.)

to defense, has limited their availability to the foundries for making ductile iron, and it has been necessary to rely largely on scrap.

At present there are approximately 200 companies in this country, Canada, and abroad, operating 500 to 600 foundries, in all parts of the world, outside of the Iron Curtain, licensed to produce ductile iron. Castings range from those weighing a few ounces, with sections as light as 0.1 in. thick, to 50-ton anvil blocks having sections 48 in. thick.

During three years' experience, foundrymen have noted that the mechanical and other properties of ductile iron combine those of gray iron, malleable iron, and steel.

All these broad ranges of utility of ductile iron have been found to be further widened by its inherent advantages in production as compared with other ferrous materials.

Ductile iron, because it can be produced in the cupola and because of its fluidity, has wide flexibility with respect to the size, intricacy, and number of castings that can be produced at any given time. For example, one foundry operated by a manufacturing concern in the United States processed 415 individual parts in one month, ranging in weight from 5 to 2000 lb.

According to Inco, it is possible with a cupola operation to meet a greatly varied demand with respect to the type of castings produced. Its compositional limits are broad, a wide variety of materials can be used for the base iron, and castings which may not meet specifications in the as-cast condition can be very simply heat-treated to harmonize with the requirements. While technical control is required, this control is simpler and the foundry problems less than with many other materials. Its fluidity, its suitability for pressure castings, and its freedom from hot tearing, all contribute to the facility of its production.

Foundry experts believe that all these factors will combine not only to promote both an expansion of the industry itself but also open the way for an extension of foundry facilities, especially in industrial fields in which operations are essentially remote from sources of supply—such as mining, where a ductile-iron foundry can be economical to establish and operate.

Crucible Graphite Study

A RECENT National Bureau of Standards investigation indicates that, for making the crucibles used in nonferrous foundries, domestic graphites from Alabama and Pennsylvania are fully as good as the traditional imported Madagascar graphite. Furthermore, it appears from the NBS study that small-flake graphite can be used instead of the generally preferred large-flake graphite without impairing the service life of "carbon-bonded" graphite crucibles. The NBS work also indicates that the carbon-bonded type of crucible has about twice the average service life of the "clay-bonded" type. The study was conducted by the NBS refractories laboratory in cooperation with certain crucible manufacturers and nonferrous foundries.

Graphite crucibles are used by several hundred nonferrous-metal foundries throughout the United States to melt metal for casting parts indispensable for both civilian and military purposes. These crucibles are made from graphite flakes, bonded either with clay or with organic binders such as tar or pitch; the latter type is known as carbon-bonded. Graphite is similarly used in the manufacture of ladle stopper heads required by the steel industry. Until now, large-flake graphite imported from Madagascar has been used for these purposes almost to the exclusion of other graphites. Because of the strategic importance of crucible graphites, now being stockpiled, the Army-Navy Munitions Board suggested that the National Bureau of Standards undertake the present study. As a result of the NBS findings, a Pennsylvania graphite mine is being reactivated so as to insure the availability of domestic graphite if the supply of lower-cost Madagascar graphite should be cut off.

The American Crucible Company and the National Crucible Company co-operated with the Bureau in manufacturing the crucibles used for the study. Graphites from the three sources, Madagascar, Alabama, and Pennsylvania, were furnished by the Bureau to the manufacturers in various combinations of flake sizes. To prevent identification of its source by anyone other than the NBS investigators, each batch of graphite was designated only by a key letter. Except for the use of NBS-supplied graphite, the manufacturers followed their regular production procedure in manufacturing the test crucibles. Each crucible was permanently identified by number and also by a secret mark. After inspection for defects, one finished crucible of each type was taken to NBS for laboratory determination of moduli of rupture and elasticity, and the others were shipped to brass-melting foundries for tests of service life.

Six foundries co-operated in service-testing the crucibles. The selection of foundries was limited to those melting brass and having enough furnaces in operation to insure rapid progress of the tests. Each foundry received crucibles of sizes to which it was accustomed. Sizes ranged from No. 50 to No. 150 (melting capacities from approximately 180 to 470 lb of brass). Every effort was made not to upset the routine melting practices of the foundries. Carbon-bonded or clay-bonded crucibles were furnished to each foundry according to the type to which the particular foundry was accustomed. Fuels used for heating the furnaces were coke, gas, and oil. Records of each heat and other pertinent information were kept on log sheets supplied by the Bureau.

Service life of the crucibles made from the Alabama and Pennsylvania graphites averaged fully as good as that of crucibles made from Madagascar graphite. Carbon-bonded crucibles, in general, gave about twice as many heats as did clay-bonded crucibles. The number of heats before failure of carbon-bonded crucibles averaged 81.3, 107.7, and 76.0 for the Alabama, Pennsylvania, and Madagascar graphites, respectively; for the clay-bonded crucibles the corresponding figures were 40.6, 36.7, and 37.6. Graphite flakes smaller in size than those preferred by some manufacturers of carbon-bonded crucibles apparently did not impair service life.

Titanium Status

TITANIUM, already in strategic weightsaving service in aircraft construction, is undergoing intensive study by producers to broaden its application.

This was emphasized by William C. Beck, engineer, Mallory-Sharon Titanium Corporation, Niles, Ohio, in a talk before approximately 1000 present and potential government suppliers at the Watertown Arsenal. The Department of Defense, cognizant of these rapid development changes, requested this meeting to make certain that suppliers are properly briefed on this new metal.

In his talk, Mr. Beck reviewed the principal properties of titanium and its alloys, including a hint of the future.

Titanium, he said, is about 60 per cent heavier than aluminum but only about 56 per cent as heavy as alloy steels. Many of our problems as producers hinge on solving the technological problems of obtaining consistently good results by satisfying customer demands for high-tensile properties along with a good percentage elongation. Potential users are naturally concerned in a weightsaving material and many manufacturers must com-

bine and evaluate the merits of the metal particularly where physical properties must be maintained at elevated temperatures.

Good mechanical properties in the intermediate range of 400 to 800 F place titanium in an ideal position, Mr. Beck pointed out. At temperatures above 800 or 900 F, titanium loses strength and becomes embrittled during lengthy times at these higher temperatures. Also, the consensus is that titanium reactivity at higher temperatures is not going to be changed greatly. However, short-time applications have shown that higher temperatures around 2000 F can be tolerated where the metal maintains many of its desirable properties.

Titanium also possesses highly corrosive-resistant properties—much more so than other popular structural metals and to a greater extent than special alloyed steels.

Maximum ingot size, he reported, at present is 1000 lb, but with improved melting methods and larger-diameter crucibles we hope to increase this size.

Also, scrap utilization is receiving constant study—as methods of remelting are perfected, costs go down.

Mr. Beck stressed the importance of metalworking companies keeping informed on the rapid progress being made in welding, machining, extruding, and other titanium-fabricating methods, to be assured of earliest possible use of titanium in industrial product designs.

For example, the forging or rolling of the material has been investigated by many concerns previously familiar with steel fabrication and, as more work is accomplished, the experience gained by these pioneers will be most beneficial. At the present time, work to successfully extrude tube sections and shapes is under way and initial results look very promising.

The commercially pure arc-melted form is sold under the name of MST Grade III material. Physical properties for hot-worked, annealed material, are as follows: Yield strength, 60 to 85,000 psi; ultimate strength, 85 to 100,000 psi; elongation, 15 to 20 per cent; RA, 60.

This commercially pure form is most suitable where very high strength is not essential but where the fabricated part must lend itself to severe forming or welding operations. This type of material is probably the most widely used at the present time.

Titanium-base alloys have been investigated and explored by many concerns. Numerous considerations have been given to the various alloying elements and the effects they have on age hardening, stabilization of phases, strength levels, and the like. As producers, Mr. Beck indicated, his company is attempting to develop and produce alloys to meet the demands of the potential users of this metal for their specific service needs.

As an example of high-strength titanium alloys, currently being produced, one is an MST Grade 3 Al - 5 Cr which has a yield strength of 140/160,000 psi with elongations varying from 6 to 12 per cent.

Mr. Beck pointed out that his company is continually working on problems such as welding, machining, extruding, and the like—along with developing alloys reaching tensile strengths of 200,000 psi.

High-Purity Chromium

A HIGHLY refined chromium metal, malleable enough to be forged at extremely low temperatures, has been produced by metallurgists at the Albany, Ore., station of the Bureau of Mines, U. S. Department of the Interior.

The Bureau issued a report describing how the metal was produced and the malleability tests to which it was subjected. Covering research performed from August, 1950, to October, 1951, the report presents one phase of the Bureau's continuing effort to produce pure chromium on a scale large enough so that investigation of high-temperature chromium alloys may proceed without interruption.

According to the report, two methods of producing high-purity chromium were tested: Reduction of chromium chloride by magnesium, and hydrogen treatment of electrolytic chromium. Although the hydrogen-treatment method was the most successful, neither method, the report emphasizes, produced a metal that could be bent at temperatures below 325 C without cracking.

The metal produced by refining electrolytic chromium in a hydrogen atmosphere at high temperature could be forged even at liquid-air temperatures, and in sheet form it could be spot-welded to chromium or iron. Further evidence of its workability was furnished by rolling, drilling, sawing, grinding, and filling it when cold.

Although chromium cannot be said to have satisfactory ductility until it can be bent at sharp angles in ordinary temperatures without cracking, the report points out that 20 years ago no one knew that it could be worked under any conditions at all.

Besides a detailed description of the methods followed and a section devoted to miscellaneous research, the report contains 23 illustrations showing the equipment employed and the various forms of metal produced and tested.

A free copy of Report of Investigations 4905, "Malleable Chromium and Its Alloys," may be obtained from the Bureau of Mines, Publications-Distribution Section, 4800 Forbes St., Pittsburgh, Pa.

Welded Heat-Exchanger Tubes

PRODUCTION of low-cost welded aluminum heat-exchanger tubes offering double-barreled protection against corrosion has been announced by Aluminum Company of America, Pittsburgh, Pa.

The new heat-exchanger tubes are made by longitudinally butt-welding Alclad 3S-H12 aluminum-alloy sheet, rather than drawing seamless aluminum tubes. The same process may be used in making tubes for applications other than heat exchangers.

In the two standard sizes now available, 1-in-OD with 0.049-in. and 0.065-in. wall thicknesses, welded aluminum heat-exchanger tubes are said to cost 20 per cent less than

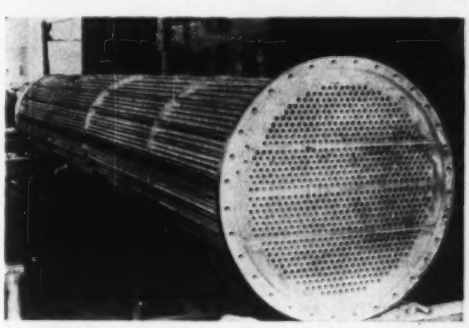


FIG. 6 THIS OIL-TO-OIL HEAT-EXCHANGER BUNDLE MADE WITH 3S-H14 ALUMINUM-ALLOY TUBES WILL BE ONE POSSIBLE APPLICATION OF THE NEW LONGITUDINALLY BUTT-WELDED HEAT-EXCHANGER TUBES

seamless aluminum tubes and substantially less per foot than tubes of other commonly used metals.

In addition to being lower in cost than tubes made from other metals, the welded heat-exchanger tubes have the protective Alclad coating on both the inside and outside surfaces rather than on the inside only, as in seamless aluminum tubes.

Weight tolerances, tube expansion, hydrostatic pressure tests, and dimension tolerances except for slight deviations in the weld area, are the same for 3S-H12 welded tubes as for seamless 3S-H14 tubes.

Typical tensile strength for Alclad 3S-H12 welded tubes is 17,000 psi and yield strength 14,000 psi. In trial installations, though allowable internal working pressures generally average two thirds those of seamless tubes, the welded tubes have performed satisfactorily.

Corrosion tests made by Aluminum Research Laboratories on the new tubes have shown that the Alclad coating gives protection to the weld area. During manufacture of the tubes the outside weld bead is removed and the small inside weld bead is flattened.

Cold Pressure Welding

A NEW device for the welding of nonferrous metals such as aluminum and copper without heat, flame, or electric current and without acids, fluxes, or chemicals, has been announced by Utica Drop Forge & Tool Corporation, Utica, N. Y., in co-operation with the Koldweld Corporation, New York, N. Y. In the case of the butt-welding of wires it is as simple as inserting the two wire ends into a small device and squeezing plierlike handles. The job is accomplished in this way in a matter of seconds. There is an actual intermolecular flow which accomplishes a small compact bond said to have a greater tensile strength than the wire itself.

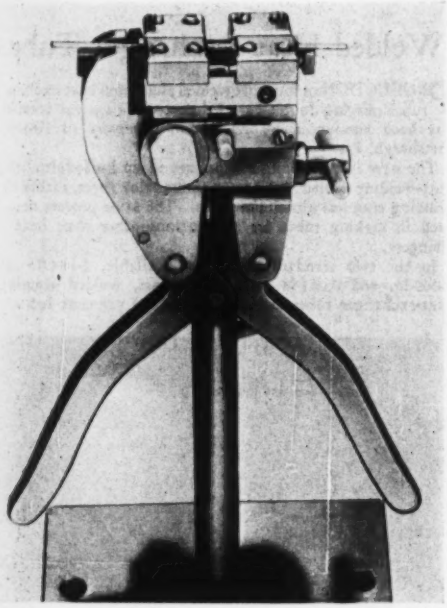


FIG. 7 HAND TOOL FOR BUTT-WELDING WIRES UP TO 0.070 IN. DIAM

(The wire ends are placed in position on top on either side through holes provided. The knob on the right is then turned, which gives the wires the correct position and prepares them for the weld. The handles are squeezed and released. This completes the weld and the wires are removed.)

FIG. 8 ENLARGED PHOTOGRAPH OF WIRE SHOWING THE BUTT WELD

(Section at right shows where wire has given way under tensile test while weld remains firm.)

The process, originating in the laboratories of the General Electric Company, Ltd., of England, is covered by some 45 patents and applications owned by G.E.C., Ltd. Sole licensee in the U.S.A. is the Koldweld Corporation.

Unlike conventional welding, in which heat anneals the metal and reduces its tensile strength, Koldwelding, it is claimed, actually work-hardens the metal. Wire can be drawn after the weld is made and tensile-strength tests show that it will ultimately part at some point remote from the weld before the weld itself will fail.

The Koldweld is such that after removal of the small flash of metal at the bond, the connection is the same gage as the wire itself, a great asset where compactness is essential, as in the manufacture of aluminum stranded cable. Where such cables are used for power transmission, this method of connection becomes very important. The clamps used at present have a tendency to loosen up, causing radio interference and disintegration at the joints. Since no exterior material or metal is used in making this connection, electrolysis is eliminated. A number of cable companies in England are in the process of adopting this method of connection for cables.

In electrical wiring of buildings the Koldweld process is said to substantially reduce fire hazard because the joint becomes integral with the wire itself and is not subject to the failure of twisted or coupled joints and highly efficient spunglass insulation can be applied. The electrician uses no flame, heat, chemicals, or electric current.

In addition to use for the butt-welding of wire, the Koldweld process can also be used in joining flat sheets of nonferrous metals. The bond is made solely by pressure, as in the case of the butt-welding of wire. The bond is said to be so strong that, under test, the metal itself will tear out before the weld fails.

Shell Molding

INTRODUCTION of shell-molded stainless-alloy castings to the West Coast was announced recently by Solar Aircraft Company, San Diego, Calif.

Shell molding, Solar said, is a new foundry technique which permits low-cost production of small intricate castings of high quality. In shell-molding, a mixture of sand and a thermal-setting plastic is used to make a thin mold which has numerous advantages over the green-sand or baked sand methods ordinarily used in foundries.

The shell-molding process works as follows:

A metal pattern is made of the object to be cast. The pattern is heated and one face covered with a powdered mixture of sand and plastic, which solidifies into a thin shell about 1/4 in. thick. After stripping the shell from the pattern, two shells are mated and make up the mold into which the molten steel is poured.

According to reports, advantages of shell molding include better surface finish on castings; better dimensional control, which often reduces or eliminates machining; and lower cost resulting from the elimination of many normal foundry operations.

Through extensive research on foundry techniques, the company is said to be able to cast many alloys not normally cast in foundries. These include Inconel, Hastelloy C, N-155, Haynes 36, and many of the AISI Type 300 and 400 series stainless steels.

Among the items being cast using the shell-molding process are support bosses, support brackets, exhaust-system selector valves, spider gears, support elbows, and aircraft hinge yokes. Experimentation with shell molding began in June, 1948, and by early 1951 production runs of thousands of shell-molded castings were being turned out.

FIG. 9 SHELLS ARE FORMED ONE HALF AT A TIME ON A HEATED PATTERN WHICH CAUSES THE MIXTURE OF SAND AND PLASTIC TO SOLIDIFY INTO A THIN SHELL
(Shells are stripped from the patterns and are mated to make the final mold.)

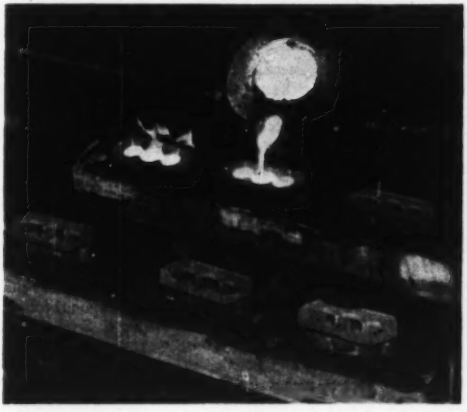


FIG. 10 POURING MOLTEN STAINLESS ALLOYS INTO SHELL MOLDS
(After the castings have cooled, they are easier to remove from the shell molds than from conventional baked sand molds.)

Copper-Clad Steel Plate

COMMERCIAL production of copper-clad steel plate, a new engineering material combining the special properties of copper and steel, has been announced by Lukens Steel Company, Coatesville, Pa. Copper-clad steels are expected to meet a long-felt want for many electrical, heat-transfer, and corrosion applications requiring copper's high conductivity and corrosion resistance combined with steel's low cost, strength, and rigidity. Applications will include electrical apparatus, evaporators, hot-water heaters, heat exchangers, tube sheets, tanks, and vessels.

Combining unique chemical and physical characteristics with good fabrication properties, copper-clad steels simplify problems of equipment and fabrication in many types of applications. Fabrication time can be cut considerably, cutting production costs. For many types of equipment a smaller thickness of copper-clad steel can serve the same purpose as a thicker section of solid copper, reducing material costs and saving space and weight.

Available in plate gages only, Lukens copper-clad steel consists of a layer of copper permanently and uniformly bonded to one side of a carbon-steel backing plate. Cladding percentages of 10, 15, or 20 per cent of total plate thickness will be regularly furnished in plate sizes up to 120 in. width, 380 in. long, and 3/16 to 1 1/4 in. thick. Copper-clad steels are also available in flanged only or flanged and dished heads.

Homogeneous and dense in structure, the copper is unchanged in any way by being bonded to the steel. Characteristic special corrosion resistance and excellent electrical conductivity are assured. Two types of cladding are regularly furnished—oxygen-free high conductivity copper for special electrical applications, and phosphorus-deoxidized copper for improved weldability. Other copper and copper alloys can also be produced in the form of clad steels.

Mechanical properties of copper-clad steel are governed by the type of backing steel used. Backing steel may be any of the plain-carbon or low-alloy steels of flange or firebox quality conforming to ASTM or ASME specifications.

These copper-clad steels can be sheared, formed, or rolled according to standard procedures. Uniformity of cladding thickness facilitates fit-up and aids welding.

The copper-clad steels are manufactured by precision assembly of predetermined thicknesses of copper and steel in "sandwich" form prior to heating and rolling. This procedure assures accurate uniform cladding thickness. Rolling the assembly under controlled even heat and pressure assures components that are permanently bonded into one integral plate. The copper surface is not exposed to the atmosphere during heating, nor is it in direct contact with the mill rolls, assuring a clean uncontaminated surface.

Bonding Agent

A NEW bonding agent, called "ChemoTec," especially formulated for joining metals to each other, to similar or dissimilar metals, or to nonmetallic materials such as ceramic,

glass, or wood, has been made available by the ChemoTec Division of Eutectic Welding Alloys Corporation, Flushing, N. Y.

The bonding agent, available in rod, powder, paste, and liquid forms, is claimed by the manufacturer to be the new method of production-joining of titanium, magnesium, aluminum, and similar difficult-to-bond metals.

In rod form it is applied with a welding-rod technique, but at a much lower heat, and tensile strengths in excess of 5000 psi have been obtained. It bonds by capillary and chemical action, has high fluidity, and the extraordinary wetting characteristics enable the thin flowing material to penetrate all but sealed joints.

The application of heat sets up a chemical reaction which changes the molecular structure and fuses or "chemocizes" the bonding material. The process gives a bond at the interface said to be equal to the tensile strength of the bonding material itself.

As is the case with thin flowing brazing alloys, maximum strength is obtained from close-fitting joints, and a joint clearance of from 0.004 to 0.008 in. should be maintained. The part to be joined is broadly heated to approximately 250 to 300 F. The rod acts as a temperature indicator, and sufficient material is applied to effect the joint. The high wettability and thin flowing characteristics enable a high-strength bond to be made irrespective of the metallurgical structure of the materials bonded.

280-Mm Gun

THE formal unveiling and a public demonstration of the Army's new 280-mm gun, which is capable of firing an atomic projectile with precision accuracy in all kinds of weather, took place on October 15 at Aberdeen Proving Grounds, Md.

Secretary of the Army Frank Pace, Jr., in his remarks prior to actual firing of the gun, declared that "this artillery piece opens up new vistas in the capabilities of our Army to discharge its primary responsibilities in the field of land combat. It provides our ground commanders with fire support of great range, flexibility, and volume, which can be delivered with extreme accuracy and reliability at any time of the day or night regardless of zero ceilings, storm, hail, or other conditions. In my view, this atomic weapon can prove to be one of the vital factors in helping to force decisive results on the battlefield."

GUN FEATURES

Significant features of the Army's new artillery piece are the following:

1 This 280-mm gun is the Army's largest-caliber artillery piece having complete mobility.

2 It is an artillery piece for firing both conventional and atomic shells.

3 It can deliver an atomic shell on target in all kinds of weather, day or night, unlike an air-delivered atomic bomb.

4 It can fire with accuracy comparable to conventional artillery in the shorter ranges and is considered to be much more accurate at long ranges—four times more accurate at long ranges than any mobile artillery pieces developed prior to World War II.

5 It is carried suspended between two engine cabs, front and rear, which can transport their load on highways at a speed of about 35 mph.

6 It is equipped with telephones to permit communication between front and rear drivers while on the move, with the leading transporter driver having control of throttle and brakes for both units, although both can be operated independently.

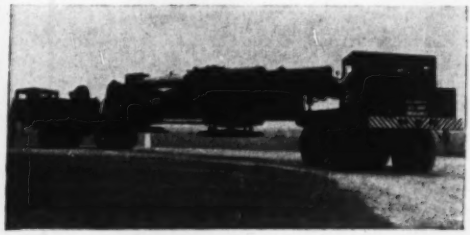


FIG. 11 THE U. S. ARMY'S NEWEST WEAPON, A 280-MM GENERATOR-POWERED GUN, TRANSPORTED BY SPECIALLY DESIGNED TRUCKS AT ABERDEEN PROVING GROUNDS, MOVES AROUND A CURVE TO THE LEFT

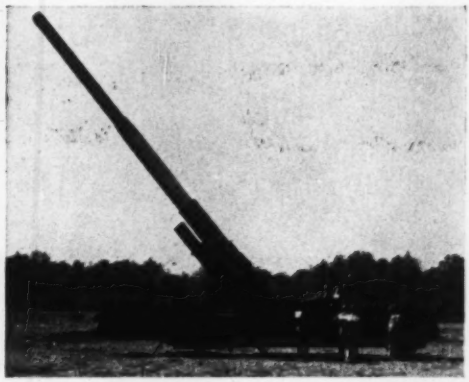


FIG. 12 NEW 280-MM GUN SHOWN IN FIRING POSITION

7 Although the complete unit ready for traveling weighs about 85 tons, it is not much larger than the heaviest field-artillery piece now in service, and can cross bridges capable of carrying any standard piece of equipment in an Army Division.

8 It can travel cross-country as well as on the highways and can fit into a landing ship designed for amphibious operations.

9 It can be emplaced and put into action with greater speed than any other heavy field-artillery pieces now in use.

10 The gun is so balanced in the vertical by a hydropneumatic equilibrator system that one man can elevate or depress it by exerting a pressure of not more than 30 lb on a handwheel in case of failure of the power unit normally provided.

11 The entire carriage is balanced on a turntable equipped with a large steel ball that fits a socket in the carriage, plus three jacks with wheels which ride a track around the circumference of the turntable. When jacked up in the rear, the carriage can be rotated horizontally through a complete circle. A gear train operated by a handwheel on which no more than 10 lb of pressure need be exerted traverses the weapon through a smaller arc. The jacks also make it possible to level the gun on uneven terrain.

12 The projectile and powder charge are loaded into the weapon's breech by means of a hydraulic power rammer though this operation may also be performed by hand.

13 The gun can give a kind of accurate and devastating close support to ground troops never before available to them in the history of warfare.

Characteristics of gun and carriage are as follows: (1) Range, about 20 miles; (2) ammunition, high explosive and other conventional types in addition to atomic shell; (3) elevation, 0 to 55 deg; (4) traverse, 360 deg; (5) carriage length (without transporters), 38.5 ft and over-all length (including transporters), 84 ft 2 in.; (6) total weight, approximately 85 tons.

TRANSPORTER

The transporter, produced by Kenworth Motor Truck Corporation of Seattle, Wash., is comprised of two end-units, having the following characteristics:

1 Each unit is powered by a six-cylinder Ordnance-Continental air-cooled gasoline engine of 375 gross horsepower.

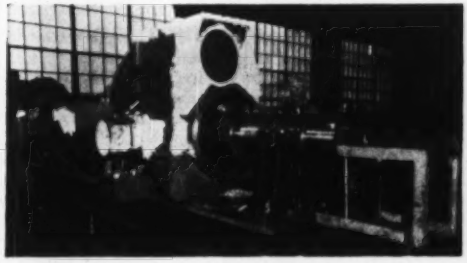


FIG. 13 CRADLE TUBE ASSEMBLY IS SHOWN BEING MACHINED ON AN ENGINE LATHE WHICH WAS CONVERTED FOR PRELIMINARY BORING

FIG. 14 RETRACTION STOP PADS ON THE CARRIAGE ARE SHOWN BEING MACHINED WITH A 26-FT PLANER

2 These six-wheeled 4 × 4 units (dual wheels in the rear) which pick up and carry the gun between them, can operate completely independent of each other, but when the carriage and mount assembly is attached, the forward unit has control of the throttle and brakes for both units.

3 The "A" or front tractor unit has its cab forward in the manner of conventional trucks, while the "B" or rear tractor has its cab at the back of the unit.

4 The pay load of the transporter is approximately 50 tons. (The largest Western highway trucks have a pay load of less than half that amount.)

5 Large carrying capacity in proportion to weight has been achieved through extensive utilization of high-tensile high-carbon steels and aluminum. These metals were used not only to accomplish weight reduction but to conserve steel.

6 Although the unit complete with transporters is 84 ft 2 in. long (the longest conventional truck-trailer used on Western highways is 60 ft), the transporters can make right-angle turns with their load at city street corners where the streets are only 28 ft wide.

7 The unit as a whole can be moved forward, backward, or sideways since either transporter can pull while the other pushes, or they can turn at right angles to the center section and proceed parallel to one another.

GUN CARRIAGE

The unique gun carriage, made by Dravo Corporation, Pittsburgh, Pa., posed numerous production problems.

Largest weldment in the assembly is the top carriage, 38½ ft long. It is made up of two double-web girders joined by transverse steel frames. Stainless-steel flanges are fixed to the bottom of the girders. Steel castings are welded inside for bearings and gears.

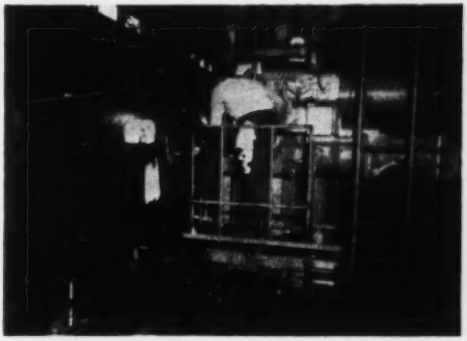


FIG. 15 GEAR HOUSINGS IN THE CARRIAGE BEING BORED

FIG. 16 CRADLE FOR THE BARREL IS SHOWN BEING ASSEMBLED TO THE CARRIAGE

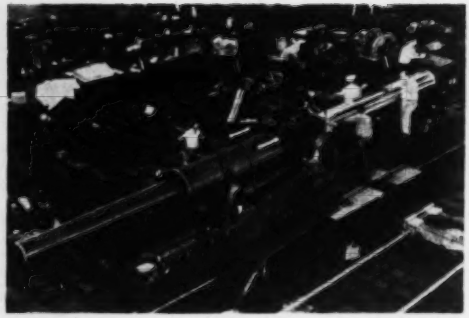


FIG. 17 FIRST PRODUCTION MODEL OF CARRIAGE FOR ARMY'S NEW 280-MM GUN IS SHOWN ON ASSEMBLY LINE AT DRAVO PLANT

To assemble the top carriage it was necessary first to fabricate subassemblies of component parts. Tolerances allowed for the subassemblies of the top carriage were only $^1/_{32}$ in. because parts had to fit closely.

The side girders of the carriage were built in special jigs. Transverse members were installed to join them. In the final welding stages of this assembly, the carriage is rotated 11 different times to permit welding according to a procedure designed to lessen distortion. All steel castings in the top carriage were preheated before being welded. After welding, the top carriage was sandblasted, given an acid bath, and painted.

First machine operation on the carriage was the stainless-steel slides. A special fixture was designed and built to support the carriage on a 26-ft planing machine. One half the slides were machined at a time; then the fixture with the carriage on it was rotated and the other half completed. A large boring mill cut the holes in the carriage for gear shafts and other parts.

The cradle tube assembly which is supported on the carriage with trunnions is a heavy alloy-steel casting, with stiffeners and trunnions of the same material. It had to be preheated to and maintained at 700 F for welding operations. Critical operation on the cradle was alignment of the two trunnions with a keyway that receives the gun barrel's key. The keyway is 3 in. wide and 8 ft long. To cut this slot within the tube, a fixture was developed to support the entire assembly on a planing machine. Using sets of progressively wider cutting tools, attached to a bar connected to the planer head, the keyway was cut.

Another special fixture had to be used for machining a rack slide which is located on the rear of the carriage to guide its movement sideways. To cut on the specified radius, a steel segment was supported on a pedestal bolted to the floor several feet away from the planing machine. The other end of the segment was attached to the planer table. Movement of the planer table drew the piece along the stationary cutting head and provided the necessary arc.

Weight of the gun carriages is a vital factor due to the necessity of transporting the weapon over bridges, culverts, and terrain which might not be sufficiently strong or stable to support it. At the same time, the carriage and its equipment have to be fabricated to resist the force of discharge recoil and stresses of being transported. Ordnance designers specified the use of many types of high-tensile, carbon, alloy, and stainless steels, plus lightweight aluminum and magnesium, and bronze and brass for the structural parts, castings, forgings, and fittings. Wherever a pound could be saved without sacrificing strength, it was done.

Welding plays a major role in fabricating the carriage. To assure stronger smoother welds, most of it is done in the downhand position. A total of approximately 8200 ft of welding is required in building one assembly and its component parts. Every weld is inspected, before and after the pieces are stress-relieved, with a Magnaflux machine or by the dye-penetration process.

As part of the program the Army demonstrated the maneuverability and firing of its latest family of three tanks—a light, medium, and a heavy—designated the T41 light gun tank (Walker Bulldog), the M47 gun tank, and the T48 medium gun tank (Patton 48).

Plastic-Pipe Research

A PLASTIC-PIPE research project has been undertaken by The Society of the Plastics Industry, Inc., at the National Sanitation Foundation at the University of Michigan. This research evaluation study is to determine the performance characteristics of plastic pipe in the transmission of water in rural supply systems.

The project was prompted by the reluctance of certain State Public Health authorities to approve the installation of plastic pipe for water transmission systems in the absence of an authoritative statement on its advantages and toxicological characteristics.

The plastic raw materials presently being tested by the National Sanitation Foundation, which is affiliated with the School of Public Health of the University of Michigan in Ann Arbor, Mich., are polyethylene, polystyrene, cellulose acetate butyrate, and copolymers of polyvinyl chloride. As the study progresses it is contemplated that additional plastic raw materials, presently being used in the manufacture of pipe, will also be tested.

Quarterly progress reports on the test findings will be issued for the information of the participating companies. At the conclusion of this research project, which will take approximately two years, a comprehensive report will be prepared and disseminated to all public health officials, colleges, and universities throughout the country.

The main objectives of the program are proof of nontoxicity and the fact that plastic materials do not impart odor and taste to water.

Machine-Tool Builders

TO commemorate the Fiftieth Anniversary of the National Machine Tool Builders Association, the October, 1952, issue of *Machinery* contains a special section of articles in which industrial and political leaders pay tribute to the machine-tool industry.

Included among the numerous contributors to the section are articles by such ASME luminaries as Charles F. Kettering, Fellow ASME, on "Manufacturing Abundance"; The Honorable Ralph E. Flanders, past-president and Honorary Member ASME, on "Machine Tools and All of Us"; Robert P. Messenger, Mem. ASME, on "Machine Tools Helped to Develop the Farm-Implement Business"; N. M. Du Chemin, Mem. ASME, on "Machine-Tool Building—Electrical Manufacturing, Partners for Greater Productivity"; and Frederick S. Blackall, jr., President and Fellow ASME, on "The Nation Needs a Virile Machine-Tool Industry." In addition, articles by The Honorable John D. Small and J. H. Kindelberger cover "National Defense Depends on Machine Tools," and "Machine-Tool Builders Meet the Needs of Airplane Manufacturers," respectively.

In his editorial, Charles O. Herb, Mem, ASME, editor of *Machinery*, pointed out that the past fifty years have witnessed the greatest industrial expansion in the history of the world—the same fifty years have seen the American machine-tool industry develop from a producer of comparatively simple hand-operated machines to a builder of complicated units capable of performing a manifold number of operations simultaneously. At the same time, the design of general-purpose machine tools has advanced tremendously in keeping up with new conceptions of metal cutting.

Machine tools, he said, have proved themselves the master tools of progress and protection for the individual and for the nation.

Locomotive Motor Testing

A NEW test facility for motor engineering development has been announced by the Locomotive and Car Equipment Department of the General Electric Company in Erie, Pa. This installation, covering 20,000 sq ft, is equipped to test traction motors and generators for locomotives beyond the size of any now being built.

Although these facilities have existed to some degree in various parts of the Works, they have now been expanded and consolidated under one roof.

The new facilities comprise 11 test tables, a soundproof room for noisemaking tests, an air chamber for motor ventilation tests, and life-test facilities for simulating service conditions. Power is supplied from a substation which covers 4500 sq ft and is totally enclosed and isolated from the general testing area.

The 11 test tables were built with the same configuration of switches and controls to permit an interchange of operating personnel with a minimum of special instruction. Although each table has been designed to handle a particular type of equipment, enough flexibility was allowed so that each can be used to test other types as well. The latest safety features such as dead-front switches, contactor compartment interlocks, and glass-enclosed high-voltage meters are incorporated.

The sound-testing room, in which the sound level has been reduced to the point where it will not affect the test results, is used to investigate noise characteristics and compare various designs of equipment. To reduce the ambient sound level from 90 to 60 decibels, the room has walls insulated with rock wool and floats on a two-foot bed of sand to isolate it from the building or foundation. The roof is removable to permit use of an overhead crane.

A large plenum air chamber, partitioned into two 10-ft cubicles by a steel wall containing nine standard calibrated nozzles, is used to study air-flow requirements for ventilating traction motors and generators and for studying the effectiveness of different fan and blower designs. The nine nozzles, which are made of spun aluminum, range in size from 2 to 16 in. in diam. By opening and closing various combinations of nozzles, air flow can be accurately measured up to 30,000 cfm.

To create various conditions of intake and exhaust, large openings are provided in the front wall of each cubicle for installation of fans and test motors. The difference in static pressure between the two chambers is measured by averaging pressures from 18 different locations in each chamber. All instruments for both air flow and electrical measurements are located centrally at the test table.

The life-test facilities permit simulating actual road conditions for a wide range of equipment over varied cycles of operation. Life tests are speeded up by the use of automatic control which also permits study of fatigue and aging under operating conditions. Safety interlocks and temperature-sensitive relays protect unattended test motors. To investigate the effect of normal weather changes, motors can be tested on an outside platform.

Much research, it was pointed out, will be devoted to increasing the output of traction motors and generators within the confines of the many design and size limitations inherent in locomotives. Increased output must be obtained, not by increasing the size of the equipment, but by working iron and copper more nearly to their limits. This causes greater heating, the effects of which will be studied through continuous heat runs.

Air-flow tests will include study into three areas: (1) Air flow versus pressure in the commutator chamber, (2) air flow versus speed of self-ventilated machines, (3) air flow versus static heads developed at constant speeds for blowers on force-ventilated equipment.

Commutation tests will consist of varying the commutating-pole flux by bucking or boosting the commutating-pole field current with an external source of power. Sparking at the brushes will be measured by observation throughout the speed-load range of the equipment.

Speed-torque characteristics will be investigated by measuring generated voltage at constant speed for prescribed loads and field excitations. Constant speed can be held to within $\frac{1}{8}$ rpm accuracy with an oscilloscope trace which is produced by modulating a fixed oscillator with the output of a tachometer generator connected to the test machine.

German Coal Planer

TESTS with a new-type German coal planer, conducted in a West Virginia mine by the U. S. Bureau of Mines in cooperation with a large mining company, may point the way to a sharp increase in the percentage of fuel that can be recovered from thin beds in this country and a corresponding increase in the nation's minable reserves of high-grade coking coal, the Department of the Interior Agency reported recently.

Under favorable conditions, the German machine cut a slice of coal 3 in. thick, about 3 ft high, and 328 ft long in 4 minutes, producing more than 8 tons of coal, the Bureau said.

An 11-acre block of coal in the Stotesbury No. 11 mine of Eastern Gas & Fuel Associates, Coal Division, at Helen, W. Va., was mined by the planer between November, 1951, and April, 1952, with 83.3 per cent of the coal being recovered. This compares with 78.1 per cent recovery in a panel mined by conventional methods in the same mine. In most American coal mines, the average recovery is about 50 per cent. The recovery of coal at the Stotesbury mine by conventional methods is considered unusually high.

A report released by the Bureau describes operation and performance of the machine in detail.

The coal planer is a continuous mining machine that can be used in beds as thin as 24 in. It mines coal as it is dragged back and forth across the solid face by an endless chain at the rate of 75 fpm. Several removable steel teeth are mounted on each cutting face. With plowlike action, the planer pushes the coal on a conveyer.

The planer and conveyer are operated by twin-drive units, one at each end of the machine, and each powered by a 50-hp electric motor. Pneumatic shifters keep the machine snugly against the coal face being mined.

Bureau of Mines coal technologists sent to Germany after V-E Day had watched a coal planer in operation, and more recently Bureau representatives saw an improved model in that country. As mechanization of mines in thin coal beds has

progressed relatively little in the United States, despite remarkable strides in mechanical mining of thick beds, the Bureau decided it would be worth while to determine whether the latest type of German planer could be adapted to American conditions.

Another factor influencing this decision was that the coal planer is designed for longwall mining. This sytem, which is seldom used in this country, results in a higher percentage of recovery than the more popular room-and-pillar method.

Except for a small amount of blasting early in the test to cause the roof to cave in the mined-out area behind the face, no explosives were used during planer mining.

A free copy of "Report of Investigations 4922—Modified Longwall Mining With a German Coal Planer in the Pocahontas No. 4 Coal Bed, Helen, W. Va.," can be obtained from the Bureau of Mines' Publications—Distribution Section, 4800 Forbes St., Pittsburgh, Pa.

Water Shortages

AN extensive study of the critical problems of water shortages in the United States is contained in a special report in the September, 1952, issue of *Power*. It is concluded that better engineering—not rainmakers or expensive schemes—is the practical answer to today's critical water shortage. And it must be backed up by law.

Last summer's almost nationwide droughts point up the threat to community health, general prosperity, and industrial profits that lies in the water shortage, the article notes. Many large cities are fighting water shortages, industrial expansion is being restricted by water availability, and vast sums are spent on development of public water projects.

While the big water projects get the headlines, supplies can be increased by more intelligent use of the water at hand, and by correcting past mistakes, the article emphasizes. In most cases the answer lies in better engineering and in learning to work with environment rather than against it.

It is pointed out that the world supply of water has been constant for millions of years and that there is no less water today than there always has been. Water just isn't always in the right place at the right time. But there is plenty for everyone.

Of all water used in the U. S., about 80 per cent comes from surface sources, 20 per cent from underground. Basic unit of surface-water supplies is the watershed, a section of terrain that may be as large as the Missouri Valley or as small as a corner of Rhode Island, that slopes to a common point for drainage. Watershed surfaces make a marked difference in surface-water runoff and river flow. Rain falling on bare hard surfaces, for instance, runs off quickly. Heavy rains may cause wasteful flash floods. Planning of dams and other works to store rainfall and regulate river flow can be of the utmost importance.

A major problem of water supply is control of stream pollution. Pollution control is largely a local job; basic power rests with the states, most of which have pollution-abatement laws, but which vary widely. We are just beginning to attack pollution problems, the article states. Most of the salvage and preservation job remains to be done. The fact that larger streams cross or border several states calls for a wider basis of regulation, such as interstate agencies like the Ohio River Valley Water Sanitation Commission. Farsighted industrialists should recognize the need and play a co-operative part in this growing program.

Use of totally new sources of water, such as desalted seawater, often are technically sound but costs are high. To be practical, such schemes must produce water at a cost not too far from today's industrial average of 10 to 12 cents per 1000 gal.

Modern "rainmakers" seek to increase rainfall by making clouds precipitate. There is no longer doubt that it can be done, but there is considerable argument as to whether they increase total rainfall or merely cause rain to fall in one place instead of another. Suits have been brought for damage from unwanted rain and for depriving nearby areas of rain they might have had. Whether such legal hurdles can be cleared remains to be seen.

One real source of untapped water lies in sewage effluent. Proper treatment can make this water usable for many purposes, even drinking. But for psychological reasons, it will not be used for human consumption unless the need gets vastly more desperate. It can be used industrially, however, and a growing number of plants are treating their own wastes.

Nuclear Laboratory

WALTER Kidde Nuclear Laboratories, said to be the first privately financed research organization devoted primarily to the development of atomic power for commercial and industrial purposes, announced that it is establishing new laboratory facilities on Long Island, outside of Garden City, to serve as headquarters for the firm's operation.

Under construction since late spring, the research and development laboratory will be ready for occupancy this month. However, the installation of certain specialized equipment needed to carry on nuclear research and development projects will continue for several months.

Typical of the activities to be undertaken at the laboratory are the following: Corrosion studies in connection with liquid metals and under special conditions encountered in the atomic field; measurement of physical and thermodynamic properties; development of special types of instruments and instrumentation systems; application of liquid metals as heat-transfer elements; measurements with radioactive sources; development and fabrication of special metals and alloys for jacketing reactor fuel elements; accumulation of original data in connection with such elements as bismuth, zirconium, beryllium, molybdenum, etc.; development of isotope separation methods; exponential studies for reactor design; fabrication of special research equipment for design and development work; material testing under special operating conditions; pilot-plant studies for determining design of full-scale installations; photomicrographic work, radio-autographic work, radiation measurements, and tracer chemistry.

The laboratory was organized to carry out the following three fundamental objectives:

1 The development of commercial atomic power, with particular emphasis on original research and development in the field of low-cost nuclear reactors. The principal personnel of the laboratories have explored this subject over the past several years, and a sustained research and development program will be conducted to further this objective.

2 Co-operation with government agencies and their contractors and subcontractors in the development and design of atomic facilities. In the past, the laboratories' staffs have worked on such strategic projects as the nuclear-powered submarine and nuclear-powered aircraft programs, and present contracts cover other important work for government agencies and contractors.

3 Collaboration with private industrial organizations, laboratories, and others interested in the application of the nuclear sciences to specific problems.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Petroleum Mechanical Engineering

Engineering Features of the Union Oil Shale Retort, by Homer C. Reed, Mem. ASME, and Clyde Berg, Mem. ASME, Union Oil Company of California, Wilmington, Calif. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-2 (mimeographed; to be published in Trans. ASME).

THE retorting of shale requires an operation combining good heat and fuel economy with low capital investment. In order to meet these demands the Union Oil Company developed its novel underfeed retorting method, which was publicly demonstrated in 1950 in a 50-ton per day unit.

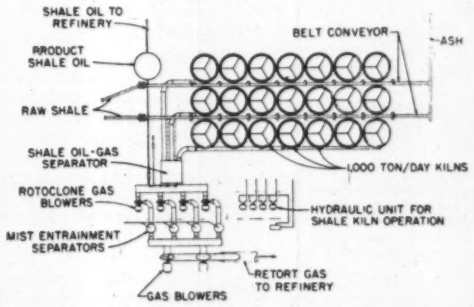
The retorting unit employs countercurrent flow of shale and air in a kiln utilizing bottom feed of solids. Ash and clinkers are removed overhead, and the oil drained from the bottom of the unit is cooled by countercurrent heat exchange with the incoming shale. No water is required for process operation. Movement of the shale through this unit is effected by a hydraulically operated underfeed mechanism. The shale kiln employs an external retorting section with cowling to direct air flow over the fins and to control shell temperature. Unlike conventional retorts, fusion of ash is not considered a problem in the operation of the Union retort since specially designed sodium-filled plows carry out a scraping action in the plastic ash-fusion zone, maintaining uniform bed porosity and size range of the discharged ash.

It has been estimated that a typical commercial shale mine can produce approximately 20,000 tons per day of shale. The shale-retorting plant designed to handle this production would employ a battery of retorts, each having a capacity of 1000 tons per day, and centralized gas handling and hydraulic-power-supply systems.

Ammonium Sulphate From Refinery Wastes, by E. D. Fox, The Fluor Corporation, Ltd., Los Angeles, Calif. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-3 (mimeographed).

THE process for manufacturing ammonium sulphate from waste acid sludge and ammonia varies only slightly from the conventional process using relatively pure sulphuric acid and ammonia. Essentially, ammonia is introduced into sulphuric acid with the resultant formation of ammonium sulphate. The ammonium sulphate is then separated by evaporative crystallization and filtration followed by drying. The available free sulphuric acid in acid sludge will react with ammonia as readily as pure sulphuric acid and therefore acid sludge may be used directly in the process without the necessity of first separating the acid phase from the oil phase. The source of ammonia required for the reaction may be either pure tank-car ammonia, or waste ammonia stripped from various refinery streams.

Manufacture of ammonium sulphate



PLAN OF 20,000-TON PER DAY SHALE-RETORTING PLANT

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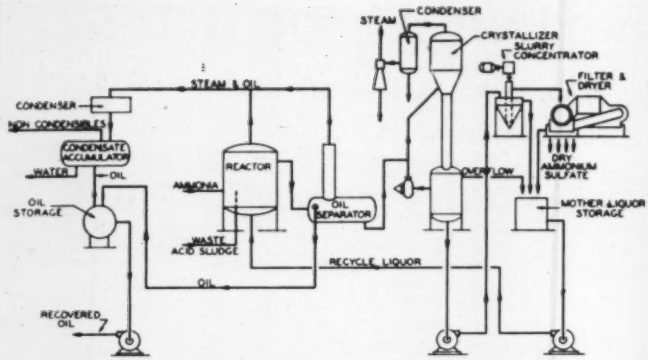


FLOW SCHEME FOR RECOVERY OF AMMONIUM SULPHATE FROM ACID SLUDGE

from refinery-waste acid sludge and ammonia has been satisfactorily worked out and put into practice on commercial scale by several refiners. This paper outlines the process used in one of these commercial installations and describes the equipment and materials of construction required for a successful application.

The process offers the refiner a profitable method of disposing of former refinery-waste by-products. This is of considerable importance due to the attention being directed by the smog-abatement authorities toward the refiners and their contribution to the smog problem resulting from burning their refinery waste. The refiner is not only able to entirely eliminate the contribution to the smog problem resulting from the burning of acid sludge, but he also is able to receive a good return from by-product sales when producing ammonium sulphate from waste acid sludge and ammonia. Present experience indicates that no major problems will exist in the application of this process to the production of ammonium sulphate from most refinery sludges. However, since the size of the ammonium sulphate crystals produced is critical both from the standpoint of drying and ultimate stability, it is recommended that tests using the specific acid sludge which is to be processed commercially, be run on a pilot-plant scale. Successful tests will assure satisfactory operation of a commercial plant.

Mechanical Features of the Cycloversion Process, by Kenneth W. Seed, Phillips Petroleum Company, Bartlesville, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-4** (mimeographed).

THE modern cycloversion process, licensed by Phillips Petroleum Company, has gained wide acceptance in the petroleum-refining industry. The cycloversion process normally consists of feed preheating and catalytic section, fractionation, stabilization, and regeneration facilities. This paper describes the mechanical features of the process. The scope has been limited to consideration of the reactors or catalyst chamber and valve switching manifolds. The feed preheater, fractionation, and stabilization equipment included in a cycloversion unit are conventional. Their design is not essentially modified to an extent that warrants special attention to the mechanical features of these particular pieces of equipment. The catalytic section has undergone several modifications and is treated in detail since the catalyst chamber is actually the heart of the process. These changes are illustrated by describing some early installations, pointing out operational difficulties, and remedial steps taken to correct the malfunctioning. This approach presents the evolution of the modern catalyst chamber and permits a better understanding of the reactor's unique design.

This paper discusses the catalytic section including materials of construction. The history of the pilot plant, on which catalytic studies were made, and the first commercial application of the process along with the early operational experiences is presented. This review of the development has been made in order to secure a better understanding of the reasons for the present design.

Crude-Oil Working Tanks: Design, Construction, Operation, and Maintenance Considerations, by R. M. Carter, Service Pipe Line Company. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-6** (mimeographed).

CRUDE-OIL tanks used as working tanks in pipe-line operations are discussed. Some of the operating and maintenance characteristics that should be considered in order to select tanks best suited to service conditions are presented and attempts are made to correlate certain design and construction features with actual service requirements.

Of the many interesting problems connected with large oil tanks, the most outstanding from a user's viewpoint are those related to utility and serviceability. Operating and maintenance considerations motivate the user's interest in design and construction, but the builder also is concerned with these aspects because of his desire to produce tankage that will meet the customer's service requirements. This paper discusses, from a user's viewpoint, some of the operating and maintenance considerations that are of common interest.

Specifically, working tanks on major pipe-line systems transporting crude oil are covered. The term "working tanks" as used, refers to tanks at pumping stations in which the oil level is fluctuating most of the time due to filling, emptying, or absorbing variations in pumping rates, as opposed to tanks containing oil in dead storage. Accelerated internal corrosion rates, filling losses of vapors, and other differences in service conditions suggest certain conclusions for crude-oil working tanks that may not hold true for oil storage tanks, or tanks handling other liquids.

One prerequisite for trouble-free operation and low maintenance is a well-built tank. Others are proper selection of type and inclusion of those design features specifically indicated for the service conditions anticipated.

Modern Steel Bolting for Piping and Pressure Vessels, by C. M. Vogrin, The M. W. Kellogg Company, New York, N. Y., Frank S. G. Williams, Mem. ASME, Taylor Forge & Pipe Works, New York, N. Y., John S. Worth, Bethlehem Steel Company, Bethlehem, Pa. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-7** (mimeographed).

THIS paper was prepared for the men in industry who select bolting for piping and pressure-vessel service. It is pointed toward a practical understanding of the many specifications and grades, their field of application, and their current availability. To this have been added a brief summary of the thinking behind allowable design values in the Codes and a discussion of design problems and field-assembly practices.

ASTM bolting specifications, current specifications and grades, dimensional requirements, code stresses, selection of

bolting, and general practices of assembly are covered.

Although there are many bolting specifications and grades, according to the paper, relatively few of them adequately cover a substantial range of usage. The engineer is therefore primarily interested in recognizing the service conditions that require careful analysis and special consideration. Purpose of this paper is to help point the way toward satisfactory bolting practice and in simplifying the problems of selecting the proper specification and grade of material.

Pipe-Line Scraper Development, by T. D. Williamson, Jr., T. D. Williamson, Inc., Tulsa, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-8** (mimeographed).

EVERY branch of the pipe-line industry is concerned with one or more problems relating to the interior condition of their pipe lines: Roughness of pipe surface, accumulation of foreign material, commingling of fuels, internal corrosion of pipe.

This group of problems is as old as the industry, but not until recent years did all three major branches of the industry—oil, products, and natural-gas pipe lines—become fully aware of the importance of these factors. For that matter, only since World War II have these problems assumed major importance, due largely to expansion of the industry, competition within the industry, and inflation of the national economy.

This paper deals with pipe-line pigs, which are tools propelled through pipe lines by the flow of oil, gas, gasoline, water, or compressed air, for the purpose of cleaning or gaging the line or for displacing or separating fluids.

The object is to analyze the design features of these tools in the light of four basic qualifications.

The scope of the pipe-line industry and its phenomenal growth during the past decade is reflected in the application of new pig designs to combat old problems more effectively and to meet new problems of larger, longer pipe lines.

This paper, intended as an analysis of pipe-line pig design, can serve only as a report of progress. The real analysis of any tool design is an analysis of the results obtained through proper use of that tool. Pipe-line pigs, as a type of tool, can be evaluated only in terms of improvement of the internal pipe-line conditions for which they were designed. Proper use is as important as the proper tool, and the net result should be measurable by a "yardstick" commonly accepted for each branch of the pipe-line industry.

Mechanical Design in Oil-Shale Retorting Plants, by Lewis H. Brakel, Bureau of Mines, Rifle, Colo. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-10** (mimeographed; to be published in Trans. ASME).

FOR retorting oil shale, the primary elements are: Handling large quantities of crushed shale in a satisfactory manner for good heat exchange, through a suitable retorting vessel; generation of the necessary heat at the temperatures required for retorting; controlled exchange of heat to the shale in the amount required for retorting; passage of a carrier fluid through the retorting shale to pick up the retorted oil; and further passage of this carrier fluid with the retorted oil through suitable equipment to separate and recover the oil from the fluid stream.

The best heat economy is possible by recovering the heat from the carrier fluid containing the retorted oil and recovering the sensible heat in the spent shale. Additional advantages are secured by making these heat exchanges directly within the retort so that only relatively cool product fluid and spent shale leave the retort. This also makes possible elimination of external cooling and the use of water.

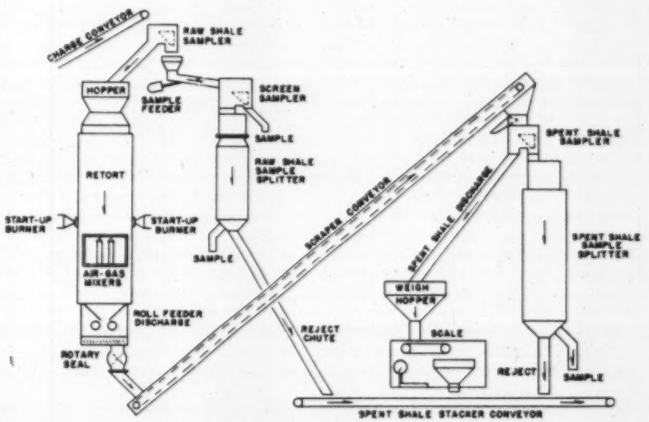
The largest single element in the design is successful economical handling of large quantities of a particular kind of crushed solid through the process. This includes taking a stock feed, passing it through preheating, retorting, and cooling to a temperature that will permit the use of economical conventional conveying equipment for disposal. The method of heating depends upon the process. Recovery of oil from a product gas stream flow is best accomplished by rotary, oil-wetted separators in series with fixed multiple-cyclone separators. There are many retorting processes that, if fully developed, would probably retort Green River oil shale, but very few could do so economically in an industry-scale plant.

Of the processes tested experimentally by the Bureau of Mines at Rifle, Colo., the gas-combustion process is most efficient and most economical in operation. No water is required. The simplicity of the design, the gravity flow of shale through the retort, the heat-exchange zones to keep all practicable heat within the retort, and the few simple mechanical devices make this retort both low in construction cost and most economical in operation.

Direct-Fired Heaters in Natural-Gasoline Plants, Their Application, Specification, and Selection, by Harold J. Born and George E. Rose, Born Engineering Company, Tulsa, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-11** (mimeographed).

ALTHOUGH the direct-fired heater is today almost universally accepted in many different types of service within a gasoline plant, for the benefit of those who may not be familiar with any or all of the varied uses to which such a heater is applicable, the following information is presented:

The fired heater has been introduced into the gasoline plant for economic reasons and for better mechanical opera-



SHALE-HANDLING SYSTEM—GAS-COMBUSTION DEMONSTRATION PLANT

tions as have been all of the other modern improvements in process methods and equipment. Originally, most heating services were handled by steam exchangers, the steam being supplied by boilers. It was obvious that large economies could be effected by substitution of a method of directly heating the oil. These economies were twofold. First, as higher-temperature processes were being required, these temperature ranges could be reached by direct-firing without the large cost of a high-pressure steam system. The use of oil as a heating medium also eliminated such expensive items as water-treating equipment and secondary-steam-recovery equipment. Second, substantial fuel savings could be made due to the fact that efficiencies of direct firing could be much higher than that of an indirect steam system. Other considerations were better control, greater responsiveness, and better mechanical operation afforded by the direct-fired heating method.

The purpose of this paper is to aid the engineer, charged with responsibility of selecting a correctly designed direct-fired heater, in specifying and selecting the best heater for service in his plant.

The various possible applications of fired heaters within a gasoline plant are also pointed out in order that the engineer may apply them wherever potential economies of operation so indicate.

Low-Temperature Insulation for Refinery Service, by W. L. Martin, Humble Oil and Refining Company, Baytown, Tex. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-12 (mimeographed; to be published in Trans. ASME).

THE problem confronting the refinery engineer in the selection, application, and maintenance of an insulation for low-temperature service involves consideration of factors that are, in general, of only minor significance in the high-temperature field. The principal basic factor in any insulation is, of course, conductivity. However, water absorption, upper temperature limit, fire resistance, coefficient of expansion, and the like, must also be considered in selecting an insulant for particular service conditions. This paper discusses the more common insulating materials and the relative importance of the various properties and characteristics of these materials for low-temperature service in petroleum refineries. In addition to the care exercised in obtaining the proper insulating material, considerable attention must be devoted to the selection of accessory materials such as adhesives, vapor sealers, water and fireproof coverings, mechanical securement devices, and the like. These materials are discussed since they have a pronounced effect on the over-all effectiveness and life of the insulation.

The high costs associated with both the extraction of heat to secure low temperatures and the application and maintenance of low-temperature insulations dictate the necessity of obtaining the most efficient, dependable, and economical insulation for each particular low-temperature operation. It is believed that optimum results will be achieved if the following procedure is adhered to in each insulation application: (1) Develop exact requirements, (2) determine service conditions, (3) obtain accurate data on properties and characteristics of materials being considered, (4) judiciously select the material that will most adequately satisfy service conditions and requirements, (5) calculate the thickness to be installed based on requirements, (6) select accessory materials as determined by requirements, service conditions, and the insulating material, (7) prepare details of design and specifications that will result in a suitable application for conditions requirements, and materials selected, (8) carefully and thoroughly inspect materials and application techniques during installation, and (9) periodically inspect and effectively maintain the insulation after it is in service.

Some Practical Considerations Regarding Pipe-Line Control-Valve Design, by Charles F. Woods, Minneapolis-Honeywell Regulator Company, Dallas, Texas. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-14 (mimeographed).

THE first section of this paper discusses instrument air-operated diaphragm-motor control valves installed in the discharge of electric centrifugal booster pumping stations for pressure-control service on closed-loop crude-oil pipe lines. For such valves, there are only two basic requirements: A minimum pressure drop, in the open position, and the ability to respond smoothly to all control demands, both major and minor.

Valves commonly in use today represent a compromise on these two requirements. Further compromise has increased the magnitude of the problem. Since effective valve characteristics seldom match inherent, or design, characteristics, a practical rather than theoretical approach is considered.

A new concept is presented, with a valve design that offers lower pressure drop at open flow, reduced operating power, with stable control under all conditions. Controlling instruments are, of necessity, brought into the consideration, but only in so far as they affect certain phases of the valve operation.

The second section of the paper discusses the use of double-ported control valves of natural-gas service in larger sizes not previously considered practicable. Conventional designs are limited in handling higher pressure drops because of the great amount of power required to position the plug. Conventional bodies may handle such drops with sufficient mechanical strengthening and the addition of very large and powerful pneumatic or hydraulic operators, but this compromise brings the cost to a much higher and usually impractical level. Conventional bodies, conventionally applied, frequently encounter difficulty due to refrigeration around the packing gland, with further hydrate formation in the downstream portion of the body. The same new design, presented in Section 1, is considered in applications where the foregoing difficulties are satisfactorily overcome.

Although primary attention has been given to valve requirements, it must be emphasized that careful consideration of instrumentation is necessary for satisfactory control.

Conceivably, there is no reason why the use of the special design should not be extended to any service where pressure drops are high, where refrigeration is a problem, and where flashing occurs. Satisfactory performance of this valve on oil pipe-line service indicates that it is no longer necessary to make an expensive sacrifice in open-flow pressure drop to obtain optimum pressure control of automatic pipe-line pumping stations. Its attendant savings in power costs should be of interest to pipe-line engineers.

Sucker-Rod Pump Mechanical Aspects, by Ralph R. Renouf, Service Engineering Enterprises, Inc., Tulsa, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-16 (mimeographed).

THE conditions under which crude oil must be produced makes it necessary for the sucker-rod pump to withstand high fluid pressures, abrasive elements, electrolysis, gaseous fluids, and corrosive elements. In spite of these adverse conditions crude oil must be produced at an economical cost. The simplicity of the positive-displacement pump has proved ideal for operation under these conditions. There are only four basic elements involved in the design of a positive-displacement pump—cylinder, the piston, the valves, and an anchor.

These four elements are present in the sucker-rod pump as the barrel, plunger, ball and seat, and hold-down.

This paper presents data regarding the mechanical aspects of sucker-rod pumps influencing the selection of a pump to combat certain well conditions. The individual components comprising the pump are further considered to assist in pump selection. The study of components compares the competitive equivalents of the barrel, plunger, balls and seats, and hold-downs. The conclusion is that all phases of the mechanics involved, design, assembly, and repair services, must be considered when selecting the pump to produce your well.

Many of the advantages and disadvantages of the standard types of pump assemblies and the manufacturing difficulties of manufacturing the components of a sucker-rod pump are discussed. There are advantages and disadvantages to each pump assembly and manufacturing difficulties in manufacturing any of the components. The best assurance of obtaining the proper-type pump for a well condition is a study of the results of the pump installations.

Economic Aspects of Natural-Gasoline Production on the Lease, by Wickliffe Skinner, Jr., Black, Sivalls and Bryson, Inc., Oklahoma City, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-17 (mimeographed).

DUE to the increasing demand for light hydrocarbon liquids, LPG, and natural gasoline, emphasis is being placed on the economics of recovering and processing condensate from natural-gas streams. This demand has encouraged the development of new processes to increase recoveries and produce end products of greater economical value. This paper discusses some of the newer methods now available for processing the gas stream and compares the economics of these processes with conventional stage separation.

In the process of stage separation, the gas and condensate are separated at the sales gas pressure and temperature which in most cases approach the ambient temperature. The pressure on the condensate is then successively reduced through a number of stages to the stock tank. The gas which is evolved in each stage is composed mainly of the light components, methane, ethane, and propane, but some of the heavier components which make up the gasoline fraction are carried off also.

The installation of small low-temperature gasoline plants on the lease shows favorable payout periods. Through the use of the systems shown in the paper the producer obtains the maximum dollar value from the well stream. Each installation must be examined individually for recoveries and plant cost, but in most cases the results will be as favorable as those discussed.

American Oil-Well Cementing Practice, by Charles W. Schoenfeld, The Bullard Company, Bridgeport, Conn. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-18 (mimeographed).

THE petroleum industry had its beginning with the drilling of Colonel Drake's well in 1859, 92 years ago, but the first serious efforts to use cement as an aid in successful well completions began in the early years of this century. The first attempts appear crude when compared with present-day methods, but the results obtained indicated that the use of cement for preventing water from contaminating the oil-producing sand was a logical approach to the problem.

The development of highly specialized equipment, accessories, related services, and improved operating techniques is constantly being studied by trained technicians maintained by various companies engaged in the work of cementing oil wells. The major oil-producing companies carry on research to study the chemical and physical properties of the materials used in cementing processes. Approximately 50,000 oil wells are cemented annually in the United States.

This paper examines the different procedures and describes some of the equipment used. Some of the more fundamental problems encountered in well completions and the methods used to correct these problems are examined.

Off-Site Facilities of an Oil-Shale Industry, by W. F. Stone, U. S. Bureau of Mines, Rifle, Colo. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-20 (mimeographed).

THERE is an enormous potential source of hydrocarbon products in the oil-shale beds of Colorado, Utah, and Wyoming. The best oil shale for industrial utilization is in northwestern Colorado. In that general area, 1000 sq miles of oil shale is regarded as being of commercial importance in the near future. For economic reasons, only the series of beds known as the mahogany ledge, which ranges up to 110 ft in thickness and averages 25 to 30 gal crude oil per ton, will be mined at first. However, there is a measure about 500 ft thick, including the mahogany ledge, that averages 15 gal per ton. It is estimated that at least 80 billion bbl of crude shale oil can be recovered from the mahogany ledge alone and that 400 billion bbl can be recovered from the 500-ft-thick measure. Shale-oil resources exist in 26 states, both in the western areas of the United States and the Devonian shales east of the Mississippi River.

In Colorado the beds are accessible by access roads connecting to existing highway and railroad facilities. Some of the access roads will necessarily be built through difficult terrain. However, the Oil-Shale Demonstration Branch gives proof that such roads are by no means impossible. Water in sufficient quantity to support enormous operations is available from the Colorado River, and no unusual treating problems are evident. Pumps and pipe lines will be the most costly part of a water utility. Design and estimate of one such plant have been made, and an actual ground survey has been established. Pumping costs in such a water utility will be much higher than in municipal plants of similar size. Electric power is potentially available in more than sufficient quantity in the oil-shale area, though development is necessary. Oil-shale processing will be self-sufficient in electric energy and will be able to supply excess power. Outside sources will be necessary to provide standby facilities and start-up power. Hydropower will be available from the development of dams now contemplated by the Bureau of Reclamation, or electric energy is available in the form of native coal situated within the area. Waste disposal is divided into two phases. The first involves treatment of water wastes and water-borne wastes to permit dumping into a natural watercourse. This phase comprises lagooning, burning of residues from lagoons, and chemical treatment of colloidal oil wastes, and removal of phenols. The second phase has to do with physical stabilization of waste piles of spent shales, which can be done by systematic construction of the waste piles, together with underdrains to remove all possible percolating moisture.

Any undertaking in the direction of utilizing shale in the production of oil will present problems in direct proportion to the scope of the project. Although cost would be high in the total amount—perhaps $5000 per daily bbl of capacity—the fact should be brought out that it would compare favorably with the cost of developing and producing an equal amount of petroleum products in any similar area that has not yet been exploited. To supplement petroleum pro-

duction and safeguard petroleum reserves in a national emergency, this country has a powerful reserve in its oil-shale resources.

An Investigation of the Bit Forces in Rotary Drilling and Their Measurement With a Bottom-Hole Weight Indicator, by Howard J. EnDean, Mem. ASME, and W. M. Laird, Gulf Research & Development Company, Pittsburgh, Pa. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-21 (mimeographed).

AN IMPORTANT consideration in rotary drilling operation is the force imposed by the bit on the formation. This force is usually measured by a weight indicator attached to the holdown or deadman line of the draw-work cable, and provides a direct reading of the net weight of the drill string suspended by the cable. The force on the bit is assumed to be the total weight of the string minus the force indicated on the weight indicator.

Recently, there has been some conjecture as to the accuracy with which existing surface-weight indicators reflect the forces imposed by the bit on the formation, both with respect to crooked-hole drilling and to errors introduced by the hydraulic forces associated with the circulation of the drilling fluid. In crooked-hole operations, it is conceivable that part of the weight of the drill string may be supported by friction between the drill pipe and the wall of the hole. Hydraulic corrections, while not significant under normal conditions of bit loading, can be of importance in low-bit weight drilling under crooked-hole conditions.

A theoretical analysis is made of the bit forces acting on a rotary-drill string, indicating that conventional surface indications of the bit force may be in error due to hydraulic forces associated with the circulation of the drilling fluid. A bottom-hole weight indicator was constructed to obtain true values of bit weight and tests were conducted on an operating drilling rig. These tests substantiate the theoretical analysis within reasonable limits.

The results of these tests may therefore be considered to validate the general theory of the bit-force picture as previously developed. The consideration of immediate interest to the drilling engineer is to what extent should this affect his thinking concerning bit weights during drilling. For drilling with or without the use of a bumper sub, it has been shown that the force on the formation is the difference between the weight of the string and the surface indicator reading minus a hydraulic correction that may be in the order of magnitude of several thousand pounds for deep wells. This correction may be important where it is necessary to maintain fixed light bit loads to avoid crooked holes. The true bit force may be determined directly from the surface reading provided the dead weight of the drill string is measured while maintaining circulation.

Recent Developments in Drill Bits and Drilling Methods, by H. B. Woods, Hughes Tool Company, Houston, Texas. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-23 (mimeographed).

THE problem of lowering the cost of drilling an acceptable oil well will always be present. Along with mounting costs of materials and labor, the average depth of holes and the percentage of hard or difficult-to-drill formations are increasing.

To keep the constantly increasing costs of drilling oil wells from becoming prohibitive, drilling contractors and oil companies with the close co-operation of progressive suppliers and manufacturers have been successful in developing and improving both oil tools and drilling methods.

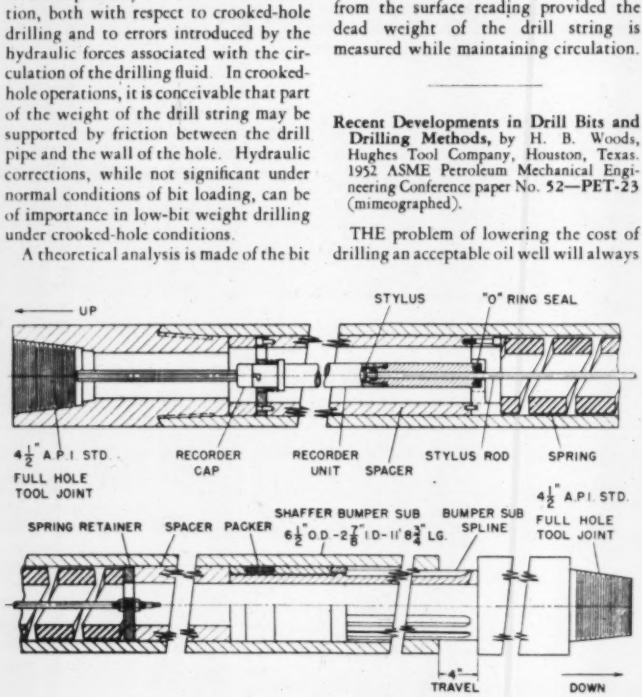
This paper discusses some of the recent developments in drill bits and drilling methods. Oil-emulsion muds, jet bits, long string of collars, and diamond bits are widely used. Experimental work with air or gas as the flushing fluid shows promise. Large-diameter collars, stabilizers, and mud-operated percussion tools are being tried for combating crooked-hole problems.

Various Methods of High-Pressure-Testing Oil-Country Tubular Material, by H. G. Texter, Spang-Chalfant Division, National Supply Company, Tulsa, Okla. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-15 (mimeographed).

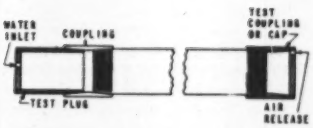
DURING the past few years most manufacturers and users of casing and tubing have learned the need of some nondestructive tests which would measure the performance properties of casing and tubing. This need has increased in importance as wells go deeper and the forces tending to burst or collapse or otherwise distort the strings have grown larger.

Until several years ago the performance properties were based on the ability of the product to meet certain API specifications. None of the requirements, however, assured the user that the completed product would adequately resist failure in a well. The API has now adopted an alternative internal-pressure test, based on 80 per cent of the minimum yield strength which is a big step toward a real measure of performance value. The full step, according to the paper would be to test each length of casing in a collapse chamber and in a tension-pulling machine as well as the burst test. Cost of these tests, however, would be prohibitive. The only worthwhile, economical performance test would be the high-internal-pressure test, the paper states.

A number of unsuspected factors are involved in carrying out these high pressure tests. For instance as the wall thickness increases and the size goes down, and as the grade of steel improves, the test pressure may climb to pretty



BOTTOM-HOLE WEIGHT INDICATOR



FIELD METHOD OF TESTING OIL CASING AND TUBING

high figures. Handling such a pressure properly and safely, and still keeping up a reasonable rate of operation, presents some interesting mechanical and mathematical problems, the discussion of which is the principal purpose of this paper. The following procedures are described: Field pressure test, present mill-test procedure, new high-pressure mill testing, and alternate method of scaling.

New Procedures in Industrial Thermal-Insulation Application, by C. J. Kuhasz, The M. W. Kellogg Company, New York, N. Y., and E. C. Shuman, Owens-Illinois Glass Company, Toledo, Ohio. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-28** (mimeographed).

IN AN attempt to reduce the installed cost of thermal insulation, methods have been developed which take advantage of the superior properties of materials which have recently become available. These include not only new application techniques but also the development of prefabricated shapes which reduce cutting and forming in the field to a minimum. In arriving at this objective numerous advantages were achieved including a saving in the amount of critical material required, reduced dependence on weather conditions during installation, greater durability, and elimination of the confusion resulting from the use of various grades and thicknesses of material. These methods have been employed on three projects now in operation and on numerous others currently under construction.

Insulation methods resulting from approximately three years of development, including extensive laboratory and field testing, and application and service experience on several commercial projects, one of which has been in operation for almost two years are described. While, in general, the methods originally developed have proved successful, certain difficulties have been experienced on large-scale installations, and modifications have been made as the result of tests. These difficulties were concerned with the weathercoating, and were: (*a*) Failure of weathercoating at the joints between blocks under extreme elevated-temperature service due to heat infiltration, (*b*) failure of bond between the insulation and weathercoating due in part to materials and in part to moisture saturation of the insulation by rain, and (*c*) failure of weathercoating due to insufficient weather and heat resistance. To avoid such difficulties and to make the method as nearly foolproof as possible the following steps were taken: (*a*) The design of joints for high-temperature service was modified to insure that the weathercoating reinforcement would not be strained excessively as a result of expansion of the metal to which the insulation is applied; (*b*) the holes for the attachments were counterbored and packed to eliminate any possibility of overheating the coat by conduction through the pins; and (*c*) all insulation was prime-coated on the outside before installing against metal surfaces, in order to minimize water absorption from unexpected rains which may occur before the weathercoat is applied on the job.

Full-Scale Fatigue Testing of Compressor Cylinders, by T. O. Kuivinen, The Cooper-Bessemer Corporation, Mount Vernon, Ohio. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-22** (mimeographed).

THE increasing demand for gas fuel throughout the country produces an ever-expanding program for the many pipe-line systems transporting natural gas from producing areas to the market. Pipe-line capacities are being increased by both larger and higher-strength pipe for the newer lines. The larger capacities and higher pressures require many large compressor engines to pump the gas through the lines. These demands present a challenge to engine and compressor manufacturers in the design of suitable reciprocating compressor cylinders to be direct-driven by these large gas engines.

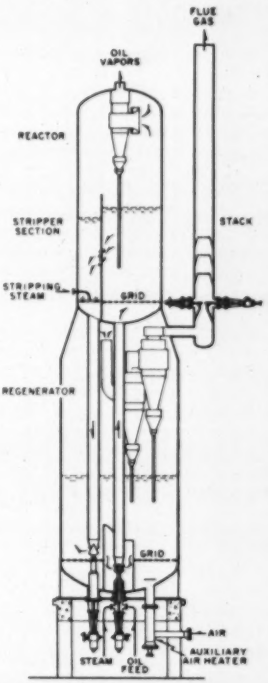
Present needs for higher-pressure compressor cylinders for natural-gas pipe lines have introduced complexities of design and manufacture. Through full-scale fatigue testing, designs incorporating high-strength cast irons are proved suitable at considerable saving to the user. Comparison of the fatigue-test failure of the design to the fatigue strength of the material used indicates the maximum safe working pressures permissible for various suction pressures. In this manner a new design is evaluated, eliminating the risks involved in former practice where field service was the only criterion of performance.

This paper presents the investigation carried out in fatigue-testing one compressor cylinder design that is in the middle of a design line having close similarity throughout its entire range.

Orthoflow Fluid Catalytic-Cracking Units —Their Design and Operation, by William J. Degnen and Joseph F. Skelly, The M. W. Kellogg Company, New York, N. Y. 1952 ASME Petroleum Mechanical Engineering Conference paper No. **52—PET-25** (mimeographed).

THE Orthoflow is a new embodiment of the fluidized catalyst-cracking process widely used in oil refineries for cracking gas oil to gasoline. The Orthoflow differs from older units in the arrangement of certain components, especially in the movement of catalyst. These points of difference are described in this paper together with results obtained in full-scale refinery service.

Three Orthoflow fluid catalytic-cracking units are now in operation while four others are being designed and erected. It is a new arrangement of the major components in the familiar fluid catalyst process for cracking gas oils to gasoline. The catalysts and the process steps em-



ORTHOFLOW CATALYTIC-CRACKING TOWER

ployed in the Orthoflow are those common to all "cat crackers," the innovations being principally concerned with the means used to bring about catalyst circulation. These result in a unit with lower first cost, improved operability, and reduced maintenance.

Remote-Control Electric-Valve Operation for Crude and Products Lines, by H. A. Altorfer, Mem. ASME, Rockwell Manufacturing Company, Oakland, Calif. 1952 ASME Petroleum Mechanical Engineering Conference paper No. 52—PET-24 (mimeographed).

THE operation of oil pipe lines is described with special emphasis on the application, selection, characteristics, and operation of valves and electrical-drive mechanisms.

The flow through pipe lines can be controlled and supervised conveniently and reliably by means of electric-valve operators over any reasonable distance, permitting the passage of several different fluids through one and the same line and to direct the stream exactly as desired with respect to the interface between the various fluids which are being pumped. Mechanization of valve control reduces labor and chances of error. Flexible operation of pumping stations with exact timing during starting and stopping cycles is readily possible.

With the assistance of the valve manufacturer, the selection of the correct size of operator and practical valve closing speed is a simple matter. The operator motor may be checked for overload and phase unbalance by measuring the current flowing in each phase. The valve is subject to the required maintenance recommended by the valve manufacturer. Ambient temperatures below the freezing point call for special attention to the matter of operator and valve lubrication.

Industrial Instruments

Rupture-Disk Design Evaluation and Bursting Tests, by G. R. Prescott, E. I. du Pont de Nemours & Company, Inc., Belle Works, Charleston, W. Va. 1952 ASME Industrial Instruments and Regulators Division-Instrument Society of America Conference paper No. 52—IIRD-8 (mimeographed).

THE use of rupture disks as a quick-acting pressure-relief device in the chemical industry is well established. High-pressure synthesis units must be adequately protected against abnormal pressure surges due to malfunctioning of equipment and chemical decompositions and reactions which may occur with explosive violence. The results of a recent investigation into the design and application of rupture disks at du Pont's Belle Works in West Virginia constitute the basis of this paper.

While some of the specific conclusions reached could possibly be translated into generalities applicable to any group of disks, the shear-strength data contained in the paper is applicable only to commercial-bronze rupture disks having identical material and heat-treatment specifications. Comparison with published data indicate that the rate of decrease of shear strength with increasing temperature is greater than the rate obtained with standard shear specimens. This may be due to the stress raising of the sharp corners created by the intersection of the web and the button.

The present specified ranges should be revised to include the sum of the ranges resulting from machine tolerances and shear-strength variation. The sharp decrease of the shear strength of commercial bronze at moderately elevated temperatures requires that rupture disks of this material be designed on the basis of both operating pressure and temperature. For design purposes, the shear-strength variation and the rate of decrease of shear strength can be combined to yield a curve showing the relation of shear strength to temperature up to 300 C. The design of a bronze and silver composite disk based on the sum of the bursting strengths of the components is not a sound procedure. Control of this composite disk is difficult due to the sharp decrease in the rupture pressure which occurs between 30 and 60 C. Above 60 C the silver contributes nothing to the total rupture pressure.

A High-Speed High-Pressure Gage, by P. L. Edwards, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. 52—IIRD-7 (mimeographed).

THE design and tests of a pressure gage for the measurement of high-speed transient pressures up to 100,000 psi is described. This gage was designed for use with the Naval Ordnance Laboratory adiabatic compressor.

The pressure gage consists of a thin x-cut quartz crystal cemented to a steel plate. The pressure bends the plate and stretches the crystal, producing an electric signal proportional to the pressure. The frequency limitations are determined by the natural modes of vibration of the steel housing.

The gage response was tested by both impulse and step input signals. The natural frequency is about 80,000 cps with a damping about 2 per cent of critical. These tests show that the gage response can be approximately represented by a resistance inductance-capacitance circuit. An analysis on this basis of the distortion by the gage of the expected pressure pulse indicates a maximum error in pressure measurement of 6 per cent. If necessary a corrective circuit may be used to reduce this to about 1.5 per cent.

The gage has been calibrated up to 50,000 psi. There is some question as to whether or not the crystal will fracture before 100,000 psi, the maximum desired pressure, is reached. If it does, the simple expedient of increasing the plate thickness will reduce the crystal strain and prevent breakage.

ASME Transactions for November, 1952

THE November, 1952, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

The Influence of Aging on the Bauschinger Effect in Inelastically Strained Beams, by T. M. Elsesser, O. M. Sidebottom, and H. T. Corten. (52—SA-8)

The Effect of Slightly Elevated-Temperature Treatment Upon Microscopic and Submicroscopic Residual Stresses Induced by Small Inelastic Strains in Metals, by H. T. Corten and T. M. Elsesser. (52—SA-7)

Additional Measurements of Heat Conductivity of Nitrogen, Carbon Dioxide, and Mixtures, by F. G. Keyes. (52—SA-10)

Performance of Finned Tubes in Shell-and-Tube Heat Exchangers, by R. B. Williams and D. L. Katz. (52—SA-43)

The Process Characteristics Which Affect Automatic Control, by J. B. McMahon and R. A. Ackley. (52—SA-3)

Instrumentation for Axial-Flow-Compressor Research, by C. A. Meyer and R. P. Benedict. (52—SA-18)

Radial-Flow Compressors and Turbines for the Simple Small Gas Turbine, by L. R. Wosika. (52—S-13)

The Free-Piston Engine Development—Present Status and Design Aspects, by A. L. London and A. K. Oppenheim. (52—S-17)

A General Theory of Three-Dimensional Flow in Subsonic and Supersonic Turbomachines of Axial, Radial, and Mixed-Flow Types, by Chung-Hua Wu. (50—A-79)

The Dynamics of Pulsative Flow Through Sharp-Edged Restrictions, by R. C. Baird and I. C. Bechtold.

Comparative Efficiencies of Central-Station Reheat and Nonreheat Steam-Turbine-Generator Units, by C. W. Elston and P. H. Knowlton. (51—A-139)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Gas-Turbine Developments

COMMENT BY P. F. MARTINUZZI[1]

The author is to be congratulated for an excellent and authoritative paper.[2] It is encouraging to see that the large American steam-turbine manufacturing firms are now considering the gas turbine a serious competitor of the steam turbine, at least up to 15,000 kw.

The Swiss industrial gas-turbine manufacturers have avoided following the aircraft gas-turbine pattern, but not for lack of aircraft-engine experience; they are convinced that the two types have such different purposes and expectation of life that it is better to design them on different principles; just as the Swiss and other European designers of large marine Diesel engines (the most efficient engines there are) deliberately turn their backs on automotive practice. Actually, three out of the five Swiss gas-turbine firms have aircraft experience; one of them builds under license the British jets for the Swiss air force. Also the very low maximum temperatures used by the Swiss are not due to lack of experience with high-temperature problems. A Swiss firm built under contract in the early 1930's, the Holzwarth gas turbine which was water-cooled. The French subsidiary of the same firm invented and tested before the war boundary-layer air cooling for turbine blades; an experimental turbine survived the German invasion and is now, apparently, being tested at very high temperature, about 1700 F.

The Swiss use low gas temperatures because with the available fuels, keeping the temperature low is still the only safe way to avoid deposits and corrosion. Temperatures of 1400 F, as quoted by the author, or 1450 F are all right if natural gas is used as a fuel. It would be interesting to hear the author's opinion on how the turbines will behave at these temperatures when using cheap and bad fuel oil. It also must be noted that the Swiss are now using gradually increasing temperatures, much higher than the 1112 F quoted by the author. It is well known that some of the large Swiss units are being modified to run at well over 1200 F. The research sections of most Swiss firms have been busily engaged for years on blade cooling. Their basic thought is to get the maximum efficiency out of compressors, turbines, and other components before resorting to temperature increases. It is true that the Swiss use many more stages for a given compression ratio; but the lightly loaded blades are perhaps better suited to resist vibration, the plague of the really large turbomachines. It would not be surprising to see that the American manufacturers will also reduce their blade loads when they start building really large compressors; vibration trouble is not unknown in large aircraft gas turbines!

It is interesting to note that the British, who have an unequaled aircraft gas-turbine experience, on the whole follow the Swiss pattern in their industrial gas turbines; high component efficiencies and not too high temperatures; though some designs tend to use rather high temperatures. The prospects of the industrial gas turbines in Britain are perhaps not quite so unfavorable as the author thinks. It is true that fuel oil is much more expensive than coal; but there is not enough coal, and imported oil uses less hard currency than imported coal. This situation is so predominant that in 1947 the British Railways started converting steam locomotives from coal to oil-burning. There are also more large units under construction in Britain than the author lists. It is interesting to note that Power Jets Ltd., the government-owned patent holding company, is also very active as an industrial gas-turbine consulting engineering firm, with contracts in several Continental countries.

As for American developments, the tendency to follow the aircraft-turbine pattern would perhaps not be so strong if some of the medium-size firms had not lost interest in industrial gas turbines. The high temperatures used are justified by the fact that at the moment natural gas fuel seems to be the most important; this does not solve the problem of cheap fuel oil, particularly in the marine gas turbine. The Navy and merchant marine are interested in gas turbines, but little or no development in that direction is visible. The aircraft-type industrial gas turbine, with can-type combustion chambers between compressor and turbine, is logical if no heat exchanger is used; but if a heat exchanger is used, the machine is needlessly long. Then a single large combustion chamber is probably cheaper and certainly more efficient.

There is no doubt that research facilities in America are so many and so well equipped that the American gas turbine can be expected to improve very substantially in the near future. It is a pity, however, that there is a complete lack of co-ordination in gas-turbine research. Consequently, the same things are tried and tried again by different firms. The only co-ordination is done by the military in so far as they have a military research program. However, the function of the military is to procure contracts and not to do technical co-ordination; also there is notoriously little co-ordination between Air Force and Navy. The British organization of gas-turbine development, though not as good as it was a few years ago, is still by far the best.

Another curious feature of American gas-turbine development is that even the richest and largest firms seem to rely mostly on government sponsorship and money for their research and development work. In contrast to this, the Swiss firms have done and are doing all their research and development work with their own money, even though their financial resources are much smaller than those of the large American firms. This insures that research money is well spent and prevents waste and duplication.

Both British and Swiss firms also seem to be more open-minded about possible future developments. For instance, in both countries the centrifugal compressor has been improved and is holding its own with the axial compressor. Some of the best European compressor specialists are confident that the centrifugal will surpass the axial in efficiency, as it already sur-

[1] Professor of Mechanical Engineering, Stevens Institute of Technology, Hoboken, N. J. Life Member ASME.

[2] "The Pattern of Gas-Turbine Development," by P. T. Hague, MECHANICAL ENGINEERING, vol. 74, August, 1952, pp. 627–632.

passes it in flexibility and reliability. Gas turbines for gas pipe-line pumping stations, which drive centrifugal compressors, could very well be equipped with centrifugal compressors. It would be interesting if the author would give his views on this subject.

COMMENT BY P. R. SIDLER[3]

The author's analysis of gas-turbine developments in Europe and the United States and his conclusions drawn from a comparison of these developments are of considerable interest to anyone active in this line.

In referring particularly to his conclusions regarding Swiss developments, with which the writer is more familiar than with those in other countries, it would appear desirable, however, to try and clarify certain misconceptions that have entered this comparison.

Basically, the differences between the approach of United States firms toward the gas-turbine problem and that of Swiss firms are not as profound as the author has concluded. Naturally, it must be the object of any gas-turbine development to achieve machines of highest over-all economy, with due regard to first costs and operating expenses including fuel consumption combined with the full reliability expected of present-day industrial equipment.

Higher temperatures, higher efficiencies of component parts, smaller and simpler machines are all very desired features as long as they contribute to the achievement of the main object.

Basic research is probably quite similar on both sides of the Atlantic. The differences in tradition, economic conditions, and available facilities no doubt are responsible for the varying degree of progress achieved along the road to a successful and commercially acceptable gas turbine.

The author states that Swiss labor rates are about 25 per cent of those in the United States. This percentage is incorrect. The proper figure would be 50 per cent as confirmed very recently by no less an authority than the NEMA.[4] It is also not correct that materials—whether conventional steels or special alloys—are cheaper in Switzerland than in this country. Indeed the prices which Swiss manufacturers have to pay for such materials are anywhere from double to four times the purchase price at which firms in the United States buy equivalent materials.

The real answer to the question why Swiss machinery along the lines discussed in this paper can be offered competitively in world markets, despite the original handicap of much higher material costs, is in the greater output per man-hour.

It is generally recognized that the workers in the Swiss machine industry enjoy a standard of living which compares favorably with that of their colleagues in other European countries and even stands comparison with the standard achieved in the U. S. machine industry. The peculiar problems for such an industry in a small country are largely to keep in healthy condition and provide a fair standard of living for its employees. The alternative to such a policy is not difficult to see; it could only be bankruptcy, unemployment and, eventually, communism and chaos. Considerations along this line determine the wage level that can be justified and at the same time would definitely prohibit any wasteful construction of machines.

The basic policy adopted by the writer's company several years ago and which is still in force today is to build technically and commercially sound gas turbines which give long-range reliable service. To achieve this basic aim it was considered necessary to stay within conservative limits regarding gas-inlet temperatures. This policy has resulted in a large number of gas-turbine units which have been in commercial operation for extended periods. The majority of these units use heavy fuel oil, bunker C, or residual oil.

The restrictions on operating temperature in regard to reliable commercial machines that have been delivered in recent years naturally do not apply to the work going on in laboratories and on the test floor. In these departments the engineers and scientists are hard at work in the development of all possibilities which will allow reliable operation at higher inlet temperatures and in their continued search for simplification in component parts and a more economical manufacturing process.

It is fully expected that these efforts in due time will show progress and allow the manufacture of even more economical units.

A well-known British technical author mentioned recently that the next few years will show whether this careful policy will prove "timid or wise." The writer's company will await the verdict of time with calm confidence, but before the final word is spoken it may be well to recall once again that the several of its gas-turbine units which are in commercial operation in various countries, burning heavy fuel oil, have proved their reliability while long-range gas-turbine operation with heavy fuel oil has yet to be demonstrated by gas turbines designed and built in this country.

COMMENT BY W. J. KING[5]

The author has done a service by presenting this interesting historical survey and appraisal of the gas-turbine developments in this country and abroad. He is well qualified to do this by virtue of his intimate contact with the gas-turbine art, as a specialist for his company in this field. The author has been an active member of the Executive Committee of the ASME Gas Turbine Power Division for several years, and is currently serving as chairman of that Division.

In spite of progress in this country perhaps we should not be too satisfied, even now, with the fact that—according to the author—we have "many times the laboratory capacity for gas-turbine development of all the rest of the world." What about the men to operate these facilities?

In 1952 there will be about 28,000 engineering graduates in the United States, while Russia will turn out 100,000 this year and next! The significance of this disparity should give us occasion for sober reflection. Perhaps we should make the practice of engineering in this country substantially more attractive, to offer greater inducements to qualified potential recruits.

The author's comments on the effect of turbine-inlet temperature upon the size and weight of the unit are interesting. It is surprising to learn that increasing the temperature from 1112 to 1400 F cuts the weight in half, "by U. S. standards."

His mention of compressor efficiencies of 90 per cent or better reminds the writer of a simple thermodynamic analysis of the gas-turbine cycle, which he made some years ago, showing that as the compressor and turbine efficiencies approach 100 per cent, the cycle efficiency becomes independent of the turbine-inlet temperature and depends only upon the pressure ratio.

The author remarks that engineers are privileged to speculate on the possibilities for further improvements in gas-turbine economy. The writer would venture to suggest that more study profitably might be given to development of means for reducing the relatively large amount of work of compression, which now constitutes a major burden upon the

[3] President, Brown Boveri Corporation (Affiliate of Brown Boveri & Company, Ltd., Baden, Switzerland), New York, N. Y. Mem. ASME.

[4] "Foreign Firms Invade United States Market," editorial, *Electrical World*, February 25, 1952, p. 67.

[5] Professor of Engineering, University of California, Los Angeles, Calif. Mem. ASME.

turbine. For example, a substantial portion of the working fluid might be compressed, with corresponding savings in compressor size and power, by injecting water into the combustor so as to flash it into steam. This would constitute a hybrid gas-steam turbine. Another approach is to employ a pulsating or rotary combustion chamber—or any other means—to secure a substantial rise in pressure after compression, as a result of the rise in temperature. This was attempted years ago in the Holzwarth explosion turbine—which was abandoned—but it may well be that some modification of the idea might retain the advantages and avoid the shortcomings of the earlier attempts.

In any event we should not lose sight of the fact that any reduction in the proportion of turbine power consumed by the compressors should yield excellent dividends in net turbine output.

AUTHOR'S CLOSURE

The comments of all discussers are very informative and helpful in developing a fuller understanding of the gas-turbine development pattern in the various countries contributing to its reduction to practice.

In making such a survey there is an inferred application of yardsticks to the effectiveness of methods and objectives of all countries in an endeavor to interpret the reasons behind different development patterns. It is not intended to pass judgment on which country's system is best but rather to give a perspective that will make differences more understandable.

A common technology guides the efforts of every country, and each in view of its individual economic and political pattern is making a commendable contribution to a new growing industry. The gas-turbine problems are legion and are a challenge to engineers' ingenuity in all countries. The record of development progress to date should convince the most skeptical that there will be a gas turbine in everyone's future and it will be a dependable, commercial machine.

F. T. HAGUE.[6]

[6] Aviation and Gas Turbine Consultant, Westinghouse Electric Corporation, Philadelphia, Pa. Mem. ASME.

Fork-Truck Operators

COMMENT BY SAM L. MACKAY[7]

In evaluating rejects from the applicants during operators' first actual driving test, as mentioned in the paper,[8] what if any was the predominant fault found by the authors? Also, did youthfulness and relative lack of maturity play a noticeable part in disqualifying a potential operator?"

COMMENT BY CLIFFORD R. MAKI[9]

In establishing a driver training program for fork-truck operators, the problem is encountered of training old operators in better driving habits. These drivers sometimes have had many years of driving experience and may be quite obstinate in correcting bad habits. What solution can be offered to cope with this problem?

If drivers do not continue to be observant of the established driving rules, what methods are best to use for correction, short of discharge?

[7] Manager, Engineering & Machinery Ltd., Vancouver, B. C. Mem. ASME.

[8] "Selecting and Training Fork-Truck Operators," by D. R. Holm, MECHANICAL ENGINEERING, vol. 74, July, 1952, pp. 568–572.

[9] Engineering Division, Longview Fibre Company, Longview, Wash. Jun. ASME.

AUTHOR'S CLOSURE

The author wishes to thank members of the Society for the great deal of interest and stimulating comment this paper aroused. It is an indication of the great importance now being attached to this subject in progressive firms using lift trucks here and in other countries.

The points raised by Mr. Mackay and Mr. Maki are extremely well taken and reflect the practical approach being taken by those firms that are concerned with solving this problem of better operator efficiency. It is interesting to note that questions of youthfulness and immaturity in new operators and stubbornness of old experienced drivers are posed, almost in one collective breath, as it were. The author believes this tends to prove that on-the-job training—which boils down to simply turning a new man loose with an expensive truck and letting him learn by experience—is inefficient and should be avoided in every case where it is practical and economical for the company to set up and conduct a program for selecting and training candidates.

Studies made of experimental tests conducted among groups of several hundred trainees or operators of both sexes and all ages show that only around 51.4 per cent qualified as drivers after five months of training because they had not first been screened and tested to determine their suitability. At the same time there was a monthly turnover of 12.5 per cent of those who did qualify, indicating that many people were being assigned to a job which they really were not fitted for, nor interested in after training. Those who failed to measure up in classroom studies and actual operating technique were found to consist mainly of a group of operators who were responsible for most of the accidents, individuals who seldom drove trucks, such as supervisory personnel, and those who had specific physical handicaps such as poor eyes, slow foot reaction or low strength. In general they were men in the upper age bracket.

In addition to being physically capable, operators must be mentally alert and possess some degree of mechanical aptitude. These two factors can be determined through standard tests such as the Scott Mental Alertness Test, Series 1, and the Stenquist Mechanical Aptitude Test No. 37096. The first test involves arithmetical reasoning, quickness and accuracy of judgment, clearness of perception, degree of comprehension, and ability to follow instructions. The second determines whether the individual is mechanically inclined or has an interest in the operation of mechanical equipment. There appears to be a high correlation between the results of this type of examining and subsequent performance as operators. Obviously, the best time to determine these factors is before the candidate is admitted to training.

Predominant faults that crop up in actual driving tests are: Stalling engine, over-controlling, traveling with forks too high, parking improperly, riding clutch, turning too sharply at high speed, stopping too suddenly, clashing gears, horse-play, improper approach to pallets, failing to look in direction traveling, racing motor, becoming flustered, poor judgment of distance. These faults, of course, are those of degree and are minimized by proper selection of desirable candidates beforehand.

Youthfulness and relative lack of maturity are negligible factors in the training of operators. In fact, studies tend to prove that the younger trainees learn faster and make better operators.

One of the most common obstacles encountered in the establishment of a formal training program for operators within a company is the resistance met in the old-timers or veteran operators who are inclined to be obstinate in correcting bad habits and are generally resentful of any attempt to improve their

efficiency or "teach them new tricks." This is a problem encountered in any program aimed at improving efficiency and is not confined to retraining old lift-truck operators. If an intelligent and tactful approach and persuasion do not work with the old-timers, there is perhaps no recourse but to transfer them to other duties, either to better jobs as company recognition of their seniority and experience or to another type of work they are better qualified to perform as results of aptitude testing indicate. Perhaps the matter can even be handled merely with a little "applied psychology," for it is probably more of an employee-relations problem than one of training.

The author has prepared an illustrated manual entitled, "How To Operate A Lift Truck," which is designed to be used by either new operators or experienced operators, individually, or in classroom work, containing a basic course in learning how to operate a lift truck. This booklet has been made available free of charge by the author's company to all interested persons and may be obtained by writing to the author.

D. R. HOLM.[10]

[10] Hyster Company, Portland, Ore.

Operation of Spreader Stokers

COMMENT BY SPENCER L. BUNTING[11]

The author of this paper[12] justifiably places emphasis on the causes and results of low-load operation of spreader stokers. One of the items which plays a major part, if not the leading role, in all spreader-stoker problems is that of coal-sizing. Coal which does not have a proper size consist can and does cause a build-up on a particular section of the grates, which can result in any one of several problems. One such instance was mentioned in the paper, where the problem was attacked, but not the cause, with the result that very little improvement was noted in operation.

The ash-fusion temperature of the coal has very little to do with the operation unless there is a build-up caused by uneven fuel-bed distribution.

Several installations visited by the writer were troubled with the fly-ash problem. In order to overcome this a double-screened coal has been instituted. This alleviated the fly-ash problem, but caused a smoking condition. In one instance where the smoke was eliminated by jets a high grate maintenance was encountered. As the author stated, overfire air is needed for proper spreader-stoker operation, but it must be applied intelligently and controlled properly. It is not a cure-all. One suggestion, particularly in the smaller-range field, is that a complete unit must be installed; that is, too many installations are found to be only half done. They do not have the proper combustion-control equipment, neither do they have proper control of overfire air and cinder reinjection, and do not have any fly-ash collection equipment whatsoever. Although the spreader stoker is by nature a versatile piece of equipment, in that it can fire a variety of coals, its versatility is greatly limited, if not eliminated altogether, when it does not have the proper auxiliary equipment, as stated.

In summation, these problems can be overcome by:

1 Installing a complete unit with proper auxiliary equipment.
2 Proper selection of fuel as to sizing.
3 Proper fuel-bed distribution.
4 Proper operation.

COMMENT BY FRANK G. FEELEY, JR.[13]

It is the writer's opinion that the problem of low loads is not of great interest to most users of large spreader stokers. Plants of the writer's company could not afford any extra expense to improve operation below one third of rated capacity. The spreader stokers we are now operating appear capable of operating with acceptable stack conditions down to about this order of low load.

The paper[14] describes operation of spreader stokers at load ranges approximating 10:1, and in one case nearly 20:1, with acceptable furnace conditions and all on automatic control. With the possible exception of natural gas, the writer knows of no other type of firing with which this is possible and there are very few users who would require such a range.

The largest spreader stokers we operate utilize a burning rate of 800,000 Btu per sq ft per hr at maximum load. At this rating stoker conditions are excellent and the writer firmly believes that there is nothing inherent in the stoker design that would cause operating or maintenance troubles at ratings well above 1,000,000 Btu per sq ft per hr of grate surface. Therefore it would appear possible to extend the load range of spreader stokers, not by seeking operation at low ratings, but by utilizing the higher ratings of which they appear capable.

The possibility of recirculating lean furnace gas for overfire air and refiring at low loads is an interesting one but it would appear to require complicated duct work and expensive fans. It would seem that an alternative and acceptable procedure might be the firing of an auxiliary fuel such as light oil or gas over the grate at low ratings. This would provide the combined functions of increasing furnace temperature and furnace turbulence. The procedure should be neither more complicated nor more expensive than the commonly accepted one of using oil ignition torches for sustaining ignition of pulverized-coal burners at low loads.

While the writer does not doubt the ability of rear-discharge spreader stokers to function satisfactorily, he has always felt that there is a lot of common sense in a front-discharge stoker both because it centralizes the points of observation and because it retains the largest pieces of coal in the burning zone for the longest period of time.

A fruitful field of endeavor would be to investigate more completely the utilization of high burning rates while retaining some acceptable low-load burning rate on the order of 100,000 Btu per hr per sq ft.

COMMENT BY J. E. NEILSON[15]

The author refers to the use of lean furnace gases for use in producing turbulence in place of overfire air. This procedure reduces the excess air at part load or, conversely, at full load it permits passage of more air through the grates than would be possible if overfire air were being used.

Air preheaters are more desirable than economizers for heat recovery from boiler flue gas because of their lower first cost for equal heat pickup. In certain very high-cost fuel markets, such as Northern Ontario, 13,500-Btu coal costs as much as $14 per ton or more. Great emphasis is thus placed on heat recovery. Often

[11] Fuel Engineer, General Coal Company, Philadelphia, Pa. Jun. ASME.

[12] Operating Spreader Stokers at Light Loads," by F. C. Messaros, MECHANICAL ENGINEERING, vol. 74, June, 1952, pp. 453-456.

[13] Design Engineer, Carbide & Carbon Chemicals Division, Union Carbide & Carbon Corporation, New York, N. Y. Mem. ASME.

[14] Practical Suggestion on Low-Load Operation of Spreader Stokers," by E. C. Miller, MECHANICAL ENGINEERING, vol. 74, June, 1952, pp. 460-462.

[15] Vice-President, Engineering, Foster Wheeler Limited, St. Catherines, Ontario, Canada.

we find that coal of low ash-fusion characteristics is the cheapest fuel.

The foregoing presents the compromise situation between high preheated-air temperatures and freedom from clinker troubles on the grates. The extra air which the author's suggestion makes available through the grates makes it possible to have higher air temperatures under the grate.

In one plant we were on the borderline for trouble with clinker when using 350 F air under the grates. The change to hot gas cleared up this trouble.

CLOSURE BY MR. MESSAROS

The author appreciates Mr. Bunting's frank discussion and confirmation of the fact that an even fuel bed is an important item in securing satisfactory and smoke-free spreader-stoker operation.

The author is also in thorough agreement with the discusser's thoughts to the effect that too often small spreader-stoke jobs are installed minus auxiliaries which are so necessary in producing a satisfactory operating installation. Such practices only result in a dissatisfied user and certainly tend to discredit the fine records being established in spreader type of firing.

F. C. MESSAROS.[16]

CLOSURE BY MR. MILLER

The author is in complete agreement with Mr. Bunting's statements concerning the effect of the size consist of the coal on low-load operation. This is not simply a matter of purchasing the correct size of coal but of caring for the coal after it has been purchased. Unless the coal is carefully and properly handled, segregation can develop between the coal car and the stoker hopper. The uniformity must be assured at the feeder.

[16] Vice-President American Engineering Co., Philadelphia, Pa. Mem. ASME.

Mr. Feeley very ably points out the necessity of considering the load range while purchasing and engineering of spreader-stoker-fired units. It would be uneconomical to include the extra equipment needed for very low-load operation when the plant conditions are such that low-load operation never occurs.

Mr. Feeley's goal of improving operations of spreaders at the higher ranges in order to more effectively utilize the abilities of spreader stokers to burn at very high rates is commendable. The work that Mr. Feeley and others are doing to obtain this goal cannot adequately be covered in a discussion of this paper.

Mr. Neilson's comments were greatly appreciated. The author's company has also found that increased air flow through the grate reduces clinker formation.

E. C. MILLER.[17]

[17] Research Engineer, Riley Stoker Corporation, Worcester, Mass. Mem. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

The Exploration of Space

THE EXPLORATION OF SPACE. By Arthur C. Clark. Harper and Brothers, New York, N. Y., 1951 (Book-of-the-Month Club Selection). Cloth, 5¼ × 8 in., plates, figs., index, xiii and 199 pp., $3.50.

REVIEWED BY G. EDWARD PENDRAY[1]

IT IS possible, I suppose, that there are still people on this planet who can observe the rising of the full moon on an autumn evening, and nevertheless feel no pang of yearning to visit its mysteries. But they must be a disappearing breed indeed, to be found principally among the old of heart, and tired of spirit, and the hard of artery.

To a lot of folks, whether scientific followers of Robert H. Goddard or adventurous followers of Captain Video, our times constitute only the dawn twilight before the coming of an Age that will see mankind liberated from antlike bondage to the Earth, freed to travel to the other planets, and perhaps to venture into outer space.

Not long ago such notions seemed about as foolish and impossible as getting power out of the atom, or possibly operating an airplane with a blast of hot air. But with rockets already tasting the edges of open space, and jet propulsion progressing on every hand, interplanetary flight no longer seems so impossible or far away. Some informed people even predict that unmanned space missiles may be sent to circle the earth within the next decade or so, and that tries at reaching and exploring the moon, if not actually attempts at colonizing it, will surely take place within the time of people now living.

There is now, of course, considerable and growing technical literature on rockets and space flight: some in print, and much more in classified reports in the United States, Canada, Britain, and undoubtedly in Russia as well. Books have been appearing on the subject ever since Dr. Robert H. Goddard's famous classical study of jet propulsion, "A Method of Reaching Extreme Altitudes," was first published by the Smithsonian Institution in 1919.

Most of these unfortunately are hard, dry going for people who do not intend to make themselves rocket or space-flight experts, but nevertheless want to know what it is all about. The task Arthur C. Clarke has undertaken in "The Exploration of Flight" is to make the whole story clear and interesting, without sacrificing scientific accuracy. He has accomplished the task so admirably that on the popular side his book has been chosen by the Book-of-the-Month Club; and on the scientific side is being widely recommended by rocket engineers, not only to their friends and relatives, but also to their associates.

Mr. Clarke exercises a scientific imagination in this book, but that is not to say he has written science fiction. His book is an explanation of how the passage to the moon and planets might be accomplished, in view of present scientific and engineering knowledge. Whether the methods Mr. Clarke describes are those that will actually be used will depend, as he himself points out, on whether or not by that time something better will have been developed.

Mr. Clarke describes the current, elaborate but apparently practical scheme of space flight, which involves the establishment of permanent "space platforms" in orbits encircling the earth, from which

[1] Industrial Public Relations Counsellor, Pendray and Company, New York, N. Y. Mem. ASME. Director and former president, American Rocket Society.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

space rockets can take off, and on which they may land again, without encountering the full force of the earth's surface gravity and the fuel costs or engineering complexities that would entail. The "space stations" would be supplied from Earth, by means of cargo and tanker rockets capable of carrying to them the fuels and other materials needed by their permanent crews and the space craft using them as bases. The stations in space, once established in their orbits, would of course require no added power to maintain themselves, since the opposing forces of inertia and gravitation, working in team as in all orbiting bodies, would attend to that.

The book is an undeniable stimulus to the imagination. It satisfies many a question that has remained vague, even to those who have been thinking a lot about space flight. In addition, it is well illustrated, with drawings, photographs, and color plates, and is clearly and simply written. Mr. Clarke is a young Englishman with a firm background in physics, aeronautics, astronomy, mathematics, and rocketry, and in this book he makes good use of his varied talents and information.

Books Received in Library

DESIGN AND USE OF CUTTING TOOLS. By Leo J. St. Clair. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, 6½ × 9¼ in., 437 pp., tables, illus., charts, diagrams. $7. The single-point tool is the basic element treated because in addition to its own wide use the principles involved in its correct design are common to the more complicated cutting tools. Chapters 2 to 13 give a detailed analysis of the various tool angles—side and end relief, angle of clearance, side and back rake, and cutting-edge angles. Attention is paid to the proper choice of tools and materials with reference to specific requirements. Chip formation and control, speeds and feeds, grinding methods, and ways of maintaining an efficient cutting edge are discussed at length.

PETROLEUM MEASUREMENT MANUAL. Institute of Petroleum, London, England, 1952. Bound, 6¼ × 9¼ in., 227 pp., diagrams, tables. 30s. An authoritative and comprehensive set of instructions and recommendations for all steps involved in measuring and calculating quantities of petroleum. Equipment and procedures are treated in detail, and the book is arranged to be usable in countries using the metric system as well as in Great Britain and the United States. The six major sections are as follows: tank calibration; oil gaging; sampling for quantitative purposes; temperature measurement; specific gravity and density measurement; calculation of oil quantities. During the preparation of the book close contact has been maintained with the ASTM Committee on Petroleum Products and Lubricants.

PROCEEDINGS OF THE FIRST WORLD METALLURGICAL CONGRESS. October 13–19, 1951. American Society for Metals, Cleveland, Ohio, 1952. Bound, 6¼ × 9¼ in., 835 pp., illus., charts, tables, graphs, diagrams. $10. Some 50 technical papers by American and foreign authorities are included in this important volume, broadly classified under the following major subject divisions: mining, melting, and refining; fabrication development and application of metals; mechanical metallurgy; surface metallurgy; physical metallurgy. The opening program and several introductory papers on metals for defense, metal reserves, and metal conservation are also included.

THEORY OF SUPERCONDUCTIVITY. By M. von Laue. Translated by Lothar Meyer and William Band. Academic Press Inc., New York, N. Y., 1952. Bound, 6¼ × 9¼ in., 140 pp., charts, graphs, $4. The aim of this book is to provide a more effective representation of the phenomena of superconductivity by extending Maxwell's electrodynamics along the lines first suggested by Fritz and Heinz London. Following a statement of fundamental facts, specific phenomena are dealt with in a more detailed manner. The final chapter presents a nonlinear extension of the theory.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretation was formulated at the Committee meeting September 19, 1952 and previously, and approved by the Board on October 30, 1952.)

CASE NO. 1159

(*Special Ruling*)

Inquiry: May alloy steels listed in SA-335 be used in the production of hollow drum forgings according to Specification SA-336?

Reply: It is the opinion of the Committee that steels listed in SA-335 may be used for the production of hollow drum forgings according to Specification SA-336. The chemical, tensile and heat treatment requirements of SA-335 shall apply. The other testing requirements of SA-335 shall be waived inasmuch as they pertain specifically to pipe rather than to forgings.

Proposed Revisions and Addenda to Boiler Construction Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1949

TABLES P-5 AND P-7. In the 1951 Addenda, under Carbon Steel Plates, opposite Specification SA-285, Grades A, B, and C, delete the stresses under 900 F.

PAR. P-200(c). Revise to read:

(c) Fusion welding may be used in lieu of threading or riveting for the attachment of stays or staybolts to plates in accordance with the following requirements:

Add the following subparagraph:

(12) Telltale holes are not required in welded staybolts.

Announcement

Table P-7, Maximum Allowable Stress Values in Tension for Ferrous Materials. This new table with the necessary revisions to Section I has been combined from present Tables P-5 and P-7 and will supersede them. This is included in the 1952 Addenda to Section I, Power Boilers, and is available through the ASME Order Department.

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved the addition to Section II of the following new specifications:

SB-149-49T, Alloy 11B, Specification for Leaded Nickel-Brass (Leaded Nickel-Silver) and Leaded Nickel-Bronze (Leaded Nickel-Silver) Sand Castings.

SB-178-52T, Specification for Aluminum and Aluminum-Alloy Sheet and Plate for Use in Pressure Vessels. This is a revision of SB-178-51T to include clad sheet and plate and to include minimum yield strength requirements.

SB-247-52T, Specification for Aluminum-Alloy Die Forgings. This is a minor revision in the composition of one alloy; otherwise the same as SB-247-50T.

SB-273-52T, Specification for Aluminum and Aluminum-Alloy Bars, Rods and Shapes for Pressure Vessel Applications.

SB-274-52T, Specification for Aluminum and Aluminum-Alloy Pipe and Tube for Pressure Vessel Applications.

SA-354-52T, Grades BB, BC, and BD* Specification for Quenched and Tempered Alloy Steel Bolts and Studs With Suitable Nuts.

* As these grades will supersede them, grades BA, BB, and BC of Specification SA-193 should be deleted.

Concerning Requirements for Spot-Radiographed Vs. Fully Radiographed Vessels in Section VIII, Unfired Pressure Vessels

From the time spot radiographing was first authorized in Section VIII as a method for inspecting welds, the requirements for retests were less stringent than those for the first examination.

Par. U-208(a) and (b) of the Pink Sheet Addenda to the 1943 Section VIII reads:

(a) Vessels constructed in accordance with Par. U-201 shall comply with the fusion welding requirements of Par. U-69 and in addition, portions of the completed welded joints shall be examined either by spot-radiographing, by sectioning, or by a combination of both methods.

(b) SPOT RADIOGRAPHING. When the welded joint is to be examined by spot-radiographing, the technique shall be that described in Par. U-68(h) and the radiograph shall comply with the standards specified in Par. U-68(h)(12) except as allowed under retests.

Par. U-68(h)(12)(a) of the 1943 Section VIII reads:

(a) Welds in which the radiographs show elongated slag inclusion or cavities exceeding the permissible limits or lack of fusion shall be unacceptable if the length of any such imperfection is greater than $\frac{1}{2}$T, where T is the thickness of the weld. If the lengths of such imperfections are less than $\frac{1}{2}$T and are separated from each other by at least 6L of acceptable weld metal, where L is the length of the longest imperfections, the weld shall be judged acceptable if the sum of the lengths of such imperfections is not more than T in a weld length of 12T.

Par. U-208(e)(1) and (2) of the Pink Sheet Addenda to the 1943 Section VIII reads:

(e) RETESTS (1) *Radiography.* When a spot has been examined by radiography and the welding does not comply with the quality requirements referred to in (b), two additional radiographs shall be taken at locations indicated by the inspector. If either of the two additional radiographs fails to meet the standards of (2), the full lengths of all the main seams shall be radiographed and all defects not permitted in (2) shall be chipped out, rewelded and radiographed.

Should the first spot radiograph fail to meet the minimum quality requirements described in (2), the full lengths of all the main seams shall be radiographed and all defects not permitted in (2) shall be chipped out, rewelded, and re-radiographed.

(2) Welds in which radiographs show elongated slag inclusions, cavities, or lack of fusion, shall be unacceptable if the length of any such imperfection is greater than $\frac{3}{4}$T, where T is the thickness of the thinner plate. If several imperfections within the above limitations exist in line, the welds shall be judged acceptable if the sum of the longest dimensions of all such imperfections is not more than T in a length of 6T, and if the defects are separated by at least 6L of acceptable weld metal, where L is the length of the shortest imperfection. The maximum length of acceptable defect for any plate thickness shall be $\frac{3}{4}$ in. Any defect shorter than $\frac{1}{4}$ in. shall be acceptable for any plate thickness. The maximum permissible porosity shall be that prescribed for Par. U-68 vessels, except that not more than twice as many cavities or slag inclusions but of no greater size, shall be permitted within any single square inch of film area, or for the whole film area.

Practically these same provisions for radiographic retests appear in the 1946, 1949, and 1950 editions of Section VIII.

Therefore, ever since spot-radiographing became an approved Code method of inspection, the final standards of acceptance have been lower than those for fully radiographed vessels, in recognition of the obvious fact that otherwise purchasers could get fully radiographed vessels for spot-radiographed prices—that is, they could for a few times, but eventually fabricators would refuse to quote them on a spot-radiograph basis.

In this connection, it should be kept in mind that fabricators of fully radiographed vessels habitually chip out and repair defects which fail to fall within Code tolerances. Their initial welds are not free from such defects.

The 1943, 1946, 1949, and 1950 editions of Section VIII required that the first spot-radiographic examination be based on the standards of a fully radiographed vessel, but that the retest or final spot radiographic examination be based on standards less rigid than those of a fully radiographed vessel. The end result of such examinations was the same as it would have been if both the initial and the retest examinations were made to the standards of the retest examinations.

The revision in March, 1952, MECHANICAL ENGINEERING and the spot radiographic standards of the 1952 Section VIII recognize this fact and require the same standard of appraisal for both the initial and final spot radiographic examinations. They also require at least 3L of acceptable weld metal between imperfections in line instead of the former 6L.

Attention is directed to the fact that the initial and final appraisal standards for spot-sectioning have been the same ever since sectioning became an authorized Code method of inspection but, until the revision of the March, 1952, MECHANICAL ENGINEERING the initial and final appraisal standards for spot-radiographing were different.

If a user of pressure vessels wishes welded joints to meet the radiographic standards for fully-radiographed vessels, he should purchase fully-radiographed vessels. If however, he buys them as spot-radiographed vessels he should expect and accept the lower standard of acceptance which is reflected in a joint efficiency 10 per cent less than for fully radiographed vessels.

Announcement

Form U-2, Manufacturers' Partial Data Report has been revised and is now available.

ASME NEWS

With Notes on the Engineering Profession

AAAS Announces Annual Meeting Program

119th Meeting to Be Held in St. Louis, Mo., Dec. 26–31

THE plans for the 119th annual meeting of the American Association for the Advancement of Science to be held in St. Louis, Mo., Dec. 26-31, 1952, clearly indicate that this meeting will be one of the most important ever held by the Association. It will be part of Washington University's Centenary, and is officially recognized as the final event of the Centennial of Engineering; but, in any event, no organization with 237 affiliates and nearly 50,000 individual members can hold an unimportant annual meeting. The general topic for the meeting will be "The Contribution of Science and Mathematics to Engineering and Industry."

Arrangements for space in the downtown hotels, the Kiel Auditorium and Washington University, have been completed. Local and regional participation and attendance are expected to substantially augment those who will come from all over the continent. Every "Big Ten" university and many other educational institutions and research laboratories are within 500 miles of St. Louis, thus assuring a considerable attendance of professional scientists.

The sectional programs and symposiums will be held in the Kiel Auditorium, the site of the large annual Exposition of Science and Industry. AAAS Science Theatre will occupy a room next to the exposition. The sessions of the societies will be held either in the downtown hotels, in classrooms of Washington University, or both. The main registration and information center, the visible directory of registrants, and the AAAS office will be in Kiel Auditorium.

AAAS Presidential Address by Kirtley F. Mather, retiring president of the association, will be given and the Reception will be held on Sunday evening, Dec. 28, 1952, at 8 p.m.

There will be two general symposiums. The first, consisting of three or four sessions, will be on Disaster Recovery—The Common Principles and Best Measures—embracing floods, earthquakes, tornadoes and hurricanes, industrial disasters, fire raids, atomic blasts; aspects to be considered include emergency measures, health measures, law and order, psychology, transport, communications, public information, legal aspects, plant rebuilding or relocation, and city planning. Participants will be national and international authorities.

The second, a two-session symposium, will be on The Nation's Nutrition: From Soil to Cytoplasm. Topics to be covered include nutritional aspects of soils, photosynthesis and plant products, animal products, microbiological sources of food, biochemistry of nutrition, caloric requirements, protein requirements, and vitamins and trace elements. Participants will be national specialists.

The sectional programs will also include sessions in the following fields: Mathematics, physics, chemistry, astronomy, geology and geography, zoological and botanical sciences, anthropology, psychology, social and economic sciences, history and philosophy of science, engineering, medical sciences, medicine, dentistry, pharmacy, agriculture, industrial science, education, and science in general.

Awards and grants which are administered by AAAS and announced at the annual meeting of the association include: Newcomb Cleveland Prize; Westinghouse Newspaper Science Writing Award; Westinghouse Magazine Science Writing Award; the Theobald Smith Award, provided by the Eli Lilly Company; AAAS Prize in Sociology; and Stillhamer Research Grants in Biology.

The 1952 convention of the Scientific Research Society of America will be held in the Ivory Room of the Jefferson Hotel, St. Louis, Mo., at 4:00 p.m., December 29. The Sigma Xi Convention is scheduled for 2:00 p.m. on the same day and in the same room. The convention date and place were selected for the convenience of those attending the AAAS annual meeting. The annual RESA Address will be given in the ballroom of the Jefferson Hotel on December 30, Tuesday evening, and will be open to all the scientists and engineers in attendance at the sessions of AAAS as well as to the citizens of St. Louis. The third award of the William Procter Prize for Scientific Achievement will be made at this time.

Section M, the engineering section of AAAS, consists of the following members: C. E. Davies, Secretary and Fellow, The American Society of Mechanical Engineers, New York, N. Y., *vice-president and chairman;* F. D. Carvin, Illinois Institute of Technology, Chicago, Ill., *secretary;* I. P. Orens, Newark College of Engineering, Newark, N. J.; G. E. Pendray, Pendray and Company, New York, N. Y.; H. B. Allen, The Franklin Institute, Philadelphia, Pa.; E. L. Chandler, American Society of Civil Engineers, New York, N. Y.; J. W. Barker, Research Corporation, New York, N. Y.; J. C. Hunsaker, Massachusetts Institute of Technology, Cambridge, Mass.; W. R. Woolrich, University of Texas, Austin, Texas; R. J. Painter, American Society for Testing Materials; Thorndike Saville, New York University, New York, N. Y.; E. E. Howard, Kansas City, Mo.; S. K. Guth, General Electric Company, Cleveland, Ohio; C. B. Sawyer, Brush Beryllium Company, Cleveland, Ohio; J. R. Van Pelt, Montana School of Mines, Butte, Mont.; P. S. Olmstead, Bell Telephone Laboratories, Murray Hill, N. J.; Gustav Egloff, Universal Oil Products Company, Chicago, Ill.; I. M. Stein, Leeds and Northrup Company, Philadelphia, Pa.; J. C. Jensen, Nebraska Wesleyan University, Lincoln, Neb.; K. S. Gibson, National Bureau of Standards, Washington, D. C.; O. B. J. Fraser, International Nickel Company, New York, N. Y.; and L. G. Farber, Columbus, Ohio.

Tentative Program of Section M

Saturday, December, 27

Concurrent Sessions 1, 2, and 3

9:30 a.m.

Session 1, Assembly Hall No. 1, Kiel Auditorium

AAAS General Symposium on Disaster Recovery: Part 1, The Nature of Disasters

Presiding: **The Common Aspects of Disasters: The Inevitability of Some,** by *Lloyd Berkner*

Natural Disasters, by *Father J. B. MacElwane,* St. Louis University

Man-Made Disasters: Industrial-Plant Explosions, Mine Disasters, Urban Conflagrations, Wartime Disasters, by *J. J. V. Forbes,* director, U. S. Bureau of Mines

The Psychology and Sociology of Disasters, by *D. G. Marquis,* University of Michigan

9:30 a.m.

Session 2, Room 4B, Kiel Auditorium

Conference on Scientific Manpower: Part 1, Current Research on Scientific Manpower; Joint Session of Section M—Engineering, Engineering Manpower Commission, and the AAAS Committee on the Teaching of Science and Mathematics.

Supply of Scientific Manpower, by *Dael Wolfle,* Commission on Human Resources and Advanced Training

Characteristics of Research Scientists, by *E. G. Williamson,* University of Minnesota

Implications for Higher Education, by *C. W. de Kiewiet,* University of Rochester

9:30 a.m.

Session 3, Assembly Hall No. 2, Kiel Auditorium

Men and Machines; Part 1—Joint Session with Sections I, M, Nm, and P

How Can We Fit Man to the Industrial Situation? *Chairman:* W. A. Hunt, Northwestern University

Can Industrial Psychology—Action Research Technology—Do the Job? by *R. M. Bellows,* Wayne University

Can Applicants, Trainees, and Workers Be Appraised Scientifically? by *E. R. Henry*, Standard Oil Company (New Jersey)

Why Not Consider the Working Environment? by *K. D. Kryter*, USAF Research and Development Command

Can We Reduce Boredom Scientifically? by *M. S. Viteles*, University of Pennsylvania

Why Not Train Industry in Human Relations? by *T. W. Harrell*, Stanford University

2:00 p.m.

Session 1, Assembly Hall No. 1, Kiel Auditorium

AAAS General Symposium on Disaster Recovery: Part 2, Disaster Recovery

Presiding: Ernest E. Howard, consulting engineer

Emergency Measures, by *J. C. Wilson*, American Red Cross

Re-establishment of Communications, by *O. G. Smith*, Illinois Bell Telephone Co.

Re-establishment of Transport, by *F. G. Gurley*, Atchison, Topeka and Santa Fe Railroad

Restoration of Community Functions, by *F. P. Zeidler*, Mayor, City of Milwaukee

Concluding remarks: **The Common Principles of Disaster Recovery,** by *E. E. Howard*

2:30 p.m.

Session 2, Assembly Hall No. 2, Kiel Auditorium

Men and Machines, Part 2

How Can We Fit the Machine to Modern Man? *Chairman: P. M. Fitts*, The Ohio State University.

Why Not Apply Mathematical Methods to Man-Machine Relationships? by *G. L. Kreezer*, Washington University

How Valid Is the Psychologist's Approach to the Design of Man-Machine Systems? by *F. V. Taylor*, Naval Research Laboratory

Man as a System Component, by *J. M. Stroud and D. R. Craig*, U. S. Navy Electronics Laboratory

Why Not Consider the Working Environment? by *J. W. Dunlap*, president, Dunlap and Associates

Successes and Failures in Changing Machines to Fit Men, by *Lieut. Col. W. F. Grether*, Wright Air Development Center, USAF

Sunday, December 28

9:30 a.m.

Room 4B, Kiel Auditorium

Conference on Scientific Manpower: Part 2, The National Science Foundation Program in Scientific Personnel and Education

Joint Session of the Conference on Scientific Manpower, AAAS Section M—Engineering, the AAAS Co-operative Committee on the Teaching of Science and Mathematics, and the Engineering Manpower Commission.

Presiding: H. C. Kelley

Fellowship Activities, by *B. C. Dees*, chief, Fellowship Section, Division of Scientific Personnel and Education

Research Training in the Sciences, by *Warren Johnson*, consultant, Division of Scientific Personnel and Education

Plans for Registers and Clearinghouse Activities, by *P. N. Powers*, consultant, Division of Scientific Personnel and Education

Monday, December 29

Concurrent Sessions 1, 2, and 3

9:00 a.m.

Session 1, Room 4C, Kiel Auditorium

Symposium

Nuclear Science in Industry: Joint Session of Sections B, M, P, and Oak Ridge Institute of Nuclear Studies

Industrial Applications of Radioisotopes, by *I. P. Orens*, Newark College of Engineering

Radioisotopes in Metallurgy, by *H. R. Spedden*, Massachusetts Institute of Technology

Problems of Industrial Nuclear Power, by *John Grebe*, Dow Chemical Co.

Nuclear Power for Industry, by *C. R. McCullough*, Monsanto Chemical Co.

Industrial Participation in the Nuclear Programs of AEC, by *W. L. Davidson*, Atomic Energy Commission

9:30 a.m.

Session 2, Room 4B, Kiel Auditorium

Conference on Scientific Manpower: Part 3, Scientists and Engineers in the Defense Program

Needed Aspects of a National Policy, by *Major Gen. M. J. Maas*, U. S. Marine Corps Reserve, Ret.

9:30 a.m.

Session 3, Room 3C, Kiel Auditorium

Symposium

Methodology in Engineering Research—Joint Session of Sections L, M, and P and Philosophy of Science Association

Presiding: C. E. Davies, Secretary, ASME

Panel

Earl P. Stevenson, Arthur D. Little Co.,
Paul S. Olmstead, Bell Telephone Laboratories
M. P. O'Brien, University of California

2:00 p.m.

Session 1, Assembly Hall No. 3, Kiel Auditorium

Symposium

Health Hazards and Health Protection, Part 1—Joint Session of Sections, NM, M, and P, and American Industrial Hygiene Association.

Presiding: W. S. McCann

Toxicology Integrates Into New Product Development, by *H. F. Smyth, Jr.*, Mellon Institute of Industrial Research

Improving Foods by Means of Chemical Additives, by *C. N. Frey*, Fleischmann Laboratories

Appropriate Additives, by *H. C. Spencer*, Dow Chemical Co.

The Importance of Metabolites in the Evaluation of the Hazards of Food Contaminants, by *E. P. Laug*, Food and Drug Administration

8:00 p.m.

Assembly Hall No. 3, Kiel Auditorium

Symposium

Health Hazards and Health Protection, Part 2—Air Pollution

Presiding: J. H. Carter

Methodology of a Comprehensive Air-Pollution Study, by *George Clayton*, U. S. P. H. S. Division of Occupational Health

The Toxicology of Chemical Air Pollutants, by *H. E. Stokinger*, U. S. P. H. S. Division of Occupational Health

Scientific Boundaries in Air-Pollutants Studies, by *W. C. L. Hemeon*, Mellon Institute

Tuesday, December 30

Concurrent Sessions 1, 2, and 3

9:30 a.m.

Session 1, Clinics and Research Building, Central Institute for the Deaf

Symposium on Hearing and Speech Aids; Communication; Co-Operation of Medicine and Engineering in Speech and Hearing

The Central Institute for the Deaf—A Living Example of Co-Operation Among the Sciences, by *S. R. Silverman*, director, Central Institute for the Deaf, and Washington University, St. Louis, Mo.

An Engineer Works With Medical Problems, by *R. W. Benson*, Central Institute for the Deaf and Washington University, St. Louis, Mo.

10:45 a.m.

Tour of Research Building including Research Laboratories and Clinical Facilities.
Joint Session of Sections M, NM, ND, and the Central Institute for the Deaf

9:30 a.m.

Session 2, Ivory Room, Hotel Jefferson

Effective Utilization of Industrial Manpower: Part 1, How Scientific is Modern Industry? Joint Session of Sections I, M, and P

10:00 a.m.

Session 3, Assembly Hall 3, Kiel Auditorium

Health Hazards and Health Protection, Part 3—Radiation Hazards

The Need for and Training of Health Physicists, by *E. Anderson*, Oak Ridge National Laboratory

Maximum Permissible Dose From Ionizing Radiation, by *K. Z. Morgan*, Oak Ridge National Laboratory

A Partial Evaluation of the Hazard From Radon and Its Degradation Products, by *William Bale and J. Shapiro*, University of Rochester

The Long-Term Toxicity of Radium, by *R. J. Hasterlik*, Argonne National Laboratory

12:30

Luncheon Meeting, Crystal Room, Hotel Jefferson

Topic: **Industrial Efficiency Is National Welfare**—Joint Session of Sections I, M, and P

2:00 p.m.

Session 1, Auditorium, Central Institute for the Deaf

Symposium on Speech and Hearing Aids—Co-Operation of Medicine and Engineering in Speech and Hearing, Part 2

Presiding: S. R. Silverman

Interarea Co-Operation in the Cleft-Palate Problem, by *O. W. Brandhorst*, Washington University, St. Louis, Mo.

Prosthodontia in Cleft Palate, by *L. W. O'Brien*, Washington University, St. Louis, Mo.

An Otologist Who Works With Psychologists, by *Ralph Naunton*, London, England, Visiting Fellow, Central Institute for the Deaf

How the Hearing-Aid Manufacturer Keeps Up With Science, by *F. W. Krauts*, Sonotone Corporation, Elmsford, N. Y.

Integrating the Disciplines, by *Hallowell Davis*, director of research, Central Institute for the Deaf and Washington University

2:30 p.m.

Session 2, Ivory Room, Hotel Jefferson

Effective Utilization of Industrial Manpower, Part 2

Program Committee

The following served on the program committee of Section M, Engineering, for the meeting: C. E. Davies, ASME, chairman; F. D. Carvin, AAAS, secretary; I. P. Orens, AAAS; E. L. Chandler, ASCE; S. L. Tyler, AIChE; E. H. Robie, AIME; H. H. Henline, AIEE; G. A. Stetson, ASME; R. C. Hogan, Office of Naval Research; M. J. Bergen, American Society for Engineering Education; A. T. Bonnell, Section P, AAAS; E. F. Murphy, Veterans Administration; Thorndike Saville, ASCE; M. C. Turpin, American Society of Refrigerating Engineers; A. V. Hutchinson, American Society of Heating and Ventilating Engineers; and P. S. Olmstead, American Society for Quality Control.

Automatic Computing Equipment Subject of Two-Day Symposium

THE place of automatic computing equipment in industry will be the subject of a two-day symposium to be held in Kansas City, Mo., Jan. 8 and 9, 1953. This meeting is sponsored by Midwest Research Institute in co-operation with local sections of The American Society of Mechanical Engineers, the American Society of Civil Engineers, American Institute of Chemical Engineers, Instrument Society of America, American Institute of Electrical Engineers, Institute of Radio Engineers, and the Society of Automotive Engineers.

Representatives from industry, government, and educational institutions throughout the country will attend this session to hear papers and discussions on such subjects as operations of digital computers, analog computers, organization of a computations center, and the application of computers to problems in the various branches of engineering. Principals from companies which manufacture computing equipment will explain the systems of their respective machines, with special attention to applications in engineering.

ASME Membership as of October 31, 1952

Honorary Members	54
Fellows	381
Members	13,493
Associates	351
Juniors (33 and over)	3,191
Juniors (30–32)	2,854
Juniors (To the age of 29)	18,543
Total	37,867

Use of computers in the automotive industry, chemical industry, aircraft production, process, control, and structural design are among the specific subjects which will be explored at this meeting.

A large portion of the program will be devoted to a round-table discussion of the engineering uses of automatic computation, allowing all participants to exchange information and ask pertinent questions of the guest speakers.

This meeting offers a unique opportunity for engineers in research and industry to get first-hand knowledge of how automatic computation can be used to advantage in solution of engineering problems.

A complete digest of the program may be obtained by writing Martin Goland in care of Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo. Advance registrations are requested and may also be placed with him.

SFSA Wins National Award

STEEL Founders' Society of America, 50-year-old technical organization serving the steel-castings industry, has been cited for national recognition as winner of the 1952 Award of Merit conferred by American Trade Association Executives, international society of professional trade-association executives.

Presentation of the award for distinguished service by a national association was based on the judgment of a five-man jury of awards of which Charles Sawyer, Secretary of Commerce, was the chairman. The presentation was made at the annual meeting of ATAE, in Toronto, Ont., Can.

Recognition of the value of these services is implicit in the permanent-award plaque presented to the Society by ATAE ". . . . for having rendered outstanding service to the industry which it represents as well as to the American public—for its excellent services to its industry and especially for its broad program of varied services to manufacturers of steel castings."

"Recently the association has given special attention to working out the best methods of inducing all members to make complete use of the wealth of research information now available."

Steel Founders' Society maintains national headquarters in Cleveland, Ohio, under the direction of F. Kermit Donaldson, executive vice-president.

Employers of Professional Engineers Cautioned Regarding Wage Stabilization

THE Office of Salary Stabilization has released Interpretation No. 12, which defines the scope of the amendment to the Defense Production Act that excludes from stabilization the salaries and other compensation of professional engineers. J. D. Cooper, executive director of the Office, points out that it was the intent of Congress to limit this exemption specifically to "professional engineers employed in a professional capacity."

Employers with salary plans are cautioned by Mr. Cooper that granting increases to professional engineers under this exemption will be basis for modification of the plan with respect to granting raises to other employees.

"In Interpretation No. 12," Mr. Cooper stated, "we have spelled out the meaning of 'professional engineer' and 'employed in professional capacity' not only to assist employers in determining the personnel who are exempt but also to guard them against taking actions that might be in contravention of the Act and regulations."

The interpretation is as follows:

A "professional engineer" is defined as (*a*) a person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience, is qualified to apply such special knowledge for the purpose of rendering professional services or accomplishing creative work, such as consultation, investigation, evaluation, planning, design, or supervision of construction for the purpose of assuring compliance with specifications and design in connection with structures, machines, processes, works, or projects; (*b*) a person is qualified as a professional engineer by reason of his professional education, if he holds a professional-engineering degree from a college, university, or institute of technology, authorized under the laws of the jurisdiction in which it is located to grant academic degrees in professional engineering; (*c*) a person licensed or registered to practice as a professional engineer in any state, territory, or possession of the United States or in the District of Columbia is qualified as a professional engineer.

Persons engaged in carrying on routine mechanical activities, or persons employed as technicians or artisans—no matter how highly skilled, advisers on sales promotion, business methods and operations, or in similar capacities, are not considered professional engineers. Consequently, persons whose occupations are designated as that of "engineer," such as stationary engineers, maintenance engineers, sales engineers, or management or administrative engineers, are not professional engineers.

The statutory exclusion from salary stabilization extends to a professional engineer only if he is employed in a professional capacity. A person is so employed if he performs engineering work of a professional character within the meaning of the Regulations, Part 541, issued by the Administrator of the Wage and Hour and Public Contracts Divisions pursuant to Section 13(a) (1) of the Fair Labor Standards Act of 1938, as amended.

A person qualified as a professional engineer may actually be employed in a position which does not involve the duties or responsibilities of a professional engineer. Such a person is not regarded as being employed in a professional capacity, even though he may be employed by a professional engineer or a firm of professional engineers.

EIC Montreal Branch Extends Co-Operation With ASME

IN KEEPING with the spirit of the co-operative agreement between The American Society of Mechanical Engineers and The Engineering Institute of Canada, the Montreal Branch of the Institute, through its mechanical section has arranged to invite all ASME members resident in the Montreal area to its meetings during the coming season.

Through the auspices of the ASME-EIC International Council names and addresses of the ASME members have been made available and commencing with the opening of the fall program, notices of all Montreal Branch meetings are being mailed to those who are not already members of the Institute.

NCSBEE Special Committee Reports on Evaluation of Teaching

A report and resolution was recently released based on the findings of the Special Committee on Evaluation of Teaching of the National Council of State Boards of Engineering Examiners.

The conclusions of the special committee set forth that (*a*) engineering is a constructive profession that utilizes basic knowledge of the properties of materials and an understanding of the principles underlying physical and chemical phenomena, together with a continuing flow of new scientific discoveries, for the design, construction, and operation of useful machines, structures, processes, factories, and products to meet the economic, social, and spiritual needs of human society; and (*b*) academic study and instruction must be supplemented by some years of nonacademic, postgraduate experience under the supervision and guidance of able professional practitioners for rapid development of professional competence in engineering; and (*c*) it is deemed of great importance that engineering-college staff members who teach professional-engineering courses shall, themselves, be competent to practice professional engineering in the fields of their courses of instruction, in order to stimu-

late and vitalize their teaching to inspire the respect and confidence of their students.

As a result of these opinions, NCSBEE, assembled at its thirty-first annual convention, Sept. 6, 1952, voted for the following recommendations: (*a*) That State Boards of Engineering Examiners, in evaluating qualifications of applicants for registration or license as professional engineers, shall require that at least one year of the qualifying engineering experience shall have been in some other area than advanced study, teaching, or research in a college or university, and shall have been under the direction of a registered or licensed professional engineer; and (*b*) that administrative officers concerned with engineering instruction in colleges and universities shall require that staff members who teach professional-engineering courses be, or be under the direct supervision of, registered or licensed professional engineers, who have had at least one year of suitable engineering experience, after graduation, in some other area than advanced study, teaching, or research in a college or university; and that such engineering experience shall be given equal recognition in respect to advancement in rank and salary, year for year up to at least two years, to the recognition given for graduate study leading toward an advanced degree.

Eighth Electronics Conference Attracts Large Audience

THE eighth annual National Electronics Conference convened at the Hotel Sherman, Chicago, Ill., from Sept. 29 through Oct. 1, 1952.

Total attendance at the three-day conference was 6165 compared to last year's attendance of 4033. Ninety-seven technical papers covering a broad field of electronic research, development, and practical application were presented by prominent scientists and engineers from all sections of the country. The technical program was supplemented by 120 booths of exhibits by manufacturers and institutions foremost in the electronics field. The theme of the 1952 conference was "Electronics for Defense and Industry."

The luncheon speaker on September 29 was E. Engstrom, vice-president in charge of the RCA Laboratories Division. In his talk "Electronics for Defense and Industry" he discussed the problems of the electronic industry today, tomorrow, and the day after tomorrow.

Major General George I. Back, chief signal officer of the United States Army, addressed the Tuesday luncheon meeting. In his address, "Communications and Electronics in the Army," General Back called upon the engineers attending the conference to help the signal corps close the gap—both in time and space—between the front-line soldier and the research scientist and engineer.

At the Wednesday luncheon meeting Harner Selvidge, director of special-products development for the Bendix Aviation Corporation, talking on "Scientific and Electronic Methodology" stated that too many electronic engineers are only high-grade technicians, ignorant of scientific mathematical methods.

The Conference was sponsored by the American Institute of Electrical Engineers, Institute of Radio Engineers, Illinois Institute of Technology, Northwestern University, and the University of Illinois, with Purdue University, University of Wisconsin, and the Society of Motion Picture and Television Engineers participating.

All the technical papers presented at the Conference will be published in Volume 8 of the "Proceedings of the National Electronics Conference." This book will be available at a cost of $5 after Jan. 15, 1953, and may be ordered from the National Electronics Conference, Inc., Karl Kramer, executive secretary, 852 East 83rd Street, Chicago 19, Ill.

Psychological Techniques in American Industry

NEW advances in the use by American industry of psychological techniques to solve personnel problems of management were reviewed by experts in the field for the benefit of six visiting French psychologists October 14 and 15, in meetings at Stevens Institute of Technology, Hoboken, N. J.

The visitors, who specialize in industrial psychology in France, are on a six-week inspection tour of American industries under the auspices of the Mutual Security Agency. Arrangements for the tour, which will include trips to industrial plants, government agencies, and universities working in industrial psychology are being handled by the National Management Council. Colonel Philip Garey, Director of Programs—U. S., of the Council, is in charge of the tour.

Colonel Garey explained that psychological methods in use by American management are much more advanced that those employed by European industrial firms. The purpose of the trip, he said, is to give the Frenchmen an opportunity to become familiar with the new methods employed here so the knowledge can be used to assist French industry in meeting production goals set by the MSA.

At Stevens, the engineering college's Laboratory of Psychological Studies, headed by Dr. F. J. Gaudet, acted as host. The first day was devoted to a discussion of the work the Laboratory is doing for industry in the selection of management personnel and in devising new means of testing hourly workers for job aptitudes. Part of the day was spent in briefing the French psychologists on the outlook and attitudes of American industry.

The second day the French psychologists attended an all-day session with representatives of eight prominent psychological consulting firms and management consultants employing staffs of industrial psychologists. Each of the eight discussed the work his organization is doing for industrial firms in meeting a variety of management problems. Among the subjects they covered were the application of new techniques in the selection of hourly employees, selection of management personnel, training and development of executive personnel, group attitudes of employees, and human engineering (designing of machines to fit the need of their operators).

The visitors were shown the Western Electric Company plant in Kearny, N. J., where they observed the work being done by its industrial-relations department. The group also toured the Prudential Life Insurance Company and viewed its work in industrial counseling as a start of the six-week tour.

Research Aimed at Manufacture of "Natural Gas"

RESEARCH at the Institute of Gas Technology, affiliated with Illinois Institute of Technology, Chicago, Ill., is leading to development of processes for the manufacture of natural-gas substitutes from coal, oil, and natural-gas condensates. Such processes are sorely needed by utility companies to improve their service to the public. This service at present is limited because the capacities of pipe lines alone are inadequate to meet all "peak-load" demands.

A report on the progress of the research highlighted the address of Director E. S. Pettyjohn at IGT's 11th annual meeting of members, and utility-gas companies which sponsored the Institute. The meeting was held in Atlantic City, N. J., Oct. 24th, on the evening of the opening day of the Financial Forum sponsored by the American Gas Association.

John T. Rettaliata, vice-president, Region VI, ASME, president of Illinois Tech and, ex officio, of the Institute of Gas Technology, presided at the meeting.

Alco Host to Educators

THE American Locomotive Company was host to more than 40 faculty members of leading Northeast engineering colleges and universities at an educators' meeting on October 16. The meeting was held in conjunction with the Diesel Engine Manufacturers Association. H. L. Weinberg, Mem. ASME, Alco director of engineering, acted as chairman.

The purpose of the special DEMA meeting was to acquaint university representatives with the engineering facilities, staff organization, and developmental projects of a modern Diesel-engine manufacturer. In addition, the visitors toured Alco's Diesel-engine and locomotive shops where they observed production techniques and equipment first-hand.

The program included the presentation of technical papers by Alco engineers as follows: "General Discussion of Alco-GE Locomotives" by K. B. Rowell, Mem. ASME; "Design of the Alco V-Type Diesel Engine" by P. S. Vaughan, Mem. ASME; "Preventative Maintenance Through Spectrographic Analysis" by H. R. Sennstrom, Mem. ASME; "Supercharging Diesel Engines" by R. J. Hooker; and "Design Considerations Affecting Combustion" by Martin Berlyn. A discussion period followed.

Engineering deans, department heads, and professors of engineering subjects from Massachusetts Institute of Technology, Harvard, Rensselaer Polytechnic Institute, Cornell, Syracuse, Columbia, New York University, Cooper Union, Polytechnic Institute of Brooklyn, University of Massachusetts, University of New Hampshire, Union College, and other universities attended the meeting.

AT THE ASME-AIME 15TH ANNUAL FUELS CONFERENCE HELD AT PHILADELPHIA, PA., OCTOBER 30-31, 1952

(*Left to right:* H. F. Yancy, recipient of the 1952 Percy Nicholls Award, Bureau of Mines, Seattle, Wash.; Dean A. A. Potter, school of engineering, Purdue University, and president of Bituminous Coal Research, Pittsburgh, Pa.; J. E. Tobey, president, Appalachian Coals, Inc.; and A. W. Thorson, general chairman, 1952 Joint Fuels Conference.)

15th Joint Fuels Conference Attracts Large Audience in Philadelphia, Pa.

THE Fifteenth Annual Joint Fuels Conference sponsored by the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers was held at the Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 30-31, 1952. More than 200 engineers and coal-company executives from several states met to take part in the symposium on the operation of domestic stokers and the sessions on the use of anthracite, the preparation of coal, and the special problems of coal and ash handling.

Large audiences and lively discussions were assured by this wide variety of subjects: Service and operating experiences on two models of peroxidizing domestic stokers, draft arrangements for domestic stokers, new types of domestic anthracite-burning equipment, use of anthracite in the Sunbury (Pa.) Station, use of oil in coal preparation, mechanics of oil treatment of coal, a new method of spraying oil at the Georgetown plant, problems of coal freezing, and cost of coal and ash-handling equipment.

The program was enthusiastically received by the registrants from all over the United States who participated in the discussions, which were a part of each session. An international flavor was added to the meeting by the presentation of the paper on cyclone dust collectors for boilers by Professor Ter Linden, Delft University, Holland.

Social Events

At a luncheon jointly presided over by Prof. W. E. Reaser, mechanical-engineering department, Princeton University, chairman of the ASME Fuel Division, and A. L. Barrett, Joy Manufacturing Company, Franklin Pa., chairman of the AIME Coal Division, a colorful film entitled "Powering America's Progress" was shown. The film produced by the Bituminous Coal Institute showed the most modern mechanical giants which are being used to bring fuel to the surface of the earth.

A high light of the conference was the banquet on Thursday evening when Dr. A. A. Potter, dean of engineering, Purdue University, and president, Bituminous Coal Research, gave the principal address entitled "Let's Look Ahead." J. E. Tobey, president of Appalachian Coals, Inc., acted as toastmaster.

"The future of civilization," said Dr. Potter, "depends on engineers with ideals, who respect the rights of others and appreciate the meaning of liberty."

The Engineer's Responsibility

"The American engineer can set an example to others by assuming his full responsibility as an intelligent and patriotic citizen for maintaining our type of government, which has emphasized the rights of the individual above those of the State, and which has made possible for us living standards unknown in other lands at any time in human history," Dr. Potter said.

"Because of his responsibility, the engineer's education is of major concern to the public," he added, explaining that engineering education in this country rests on a foundation of science, of humanities, and of social relationships. Our engineering-college graduates are making contributions where science is applied to the problems of industry, commerce, and public works, and where work must be organized systematically with due regard to human values, as well as to costs and returns.

Engineers in American Industry

American industry has long recognized the value of engineering. "This is evidenced by the fact that while our population has hardly doubled during the past 50 years, our engineers have increased by more than 13 times," he pointed out.

"Americans, more than any other people in the world, have 'the will to have,' and are willing to work hard in order to satisfy their wants," Dr. Potter asserted. "More than half of the epoch-making inventions of the past century may be traced to American creative genius, which has definitely extended gainful employment, while providing new comforts for humanity.

"Nearly half of the total employment in this country is based on the products coming from the research laboratory, and each research man provides employment for about 200 other persons. Industries which have made the most spectacular growth during the past 30 years and which have weathered best the difficult period of the 1930's, are also foremost in research," he said.

As the final high light of the evening, B. L. Metcalf of the National Coal Board, London, England, told of some of the problems of the British industry and left the group with a pleasant and kindly feeling because of his keen sense of humor and friendly manner.

Heat Transfer, 1940–1950

THE General Discussion on Heat Transfer held in The Institution of Mechanical Engineers, London, England, Sept. 11-13, 1951, was arranged by The Institution of Mechanical Engineers and The American Society of Mechanical Engineers, with the object of reviewing development in the knowledge of the principles of the transference of heat, and in the design of apparatus making use of such

knowledge, during the period 1940–1950. (*See* MECHANICAL ENGINEERING, November, 1951, pp. 948–949.)

The discussion was continued at Atlantic City, N. J., Nov. 26–28, on the occasion of the 1951 ASME Annual Meeting.

Many technical societies in the United Kingdom, the British Commonwealth, and Europe co-operated with the Institution. ASME had the co-operation of North American societies interested in heat transfer.

Ninety-three papers were presented dealing with developments in the mechanism of transference of heat and in the design of apparatus related thereto, and the subject matter for consideration was divided into five main headings as follows:

1 Heat transfer with change of state, 16 papers.
2 Heat transfer between fluids and surfaces, 23 papers.
3 Conduction in solids and fluids, 16 papers.
4 Radiation, instrumentation, measurement techniques, and analogies, 18 papers.
5 Special problems such as heat transfer in turbine-blade cooling, in liquid metals, in gas turbines, and in piston engines, the mercury boiler, and so on, 20 papers.

The Proceedings of the General Discussion on Heat Transfer, a 496-page bound volume, was recently published. In addition to the afore-mentioned 93 papers, the Proceedings contains among other items of interest, the James Clayton Lecture, "Problems in Design and Research on Condensers of Vapors and Vapor Mixtures," by A. P. Colburn, Mem. ASME, provost of the University of Delaware, and professor of chemical engineering, Newark, Del.; list of authors and participants in the discussion; and a subject-matter index. The papers are illustrated. The Proceedings may be obtained from the Order Department, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y., for $10 a copy.

Yale School of Engineering Celebrates Centennial

A LEADING industrial engineer stressed that there should be no fear about reaching a saturation point for engineering manpower in American industry.

"Continuing research will undoubtedly lead to new developments in science which in turn will lead to new applications to engineering. This technological process appears to be an inexhaustible natural resource," according to C. Guy Suits, vice-president and director of research of the General Electric Company.

Mr. Suits spoke at the opening exercises of the Centennial Celebration of the Yale School of Engineering. The two-day anniversary program included lectures by leading engineers and scientists as well as exhibitions and demonstrations of new developments in engineering in the Yale laboratories.

More than 200 engineering alumni and representatives of learned societies attended the celebration. Formal instruction in engineering at Yale began in 1852 with the appointment of William A. Norton, a West Point graduate, as the first professor of civil engineering.

In discussing the great demand for trained personnel in industry at the present time, Mr. Suits said that young men studying engineering should not worry that such demand was only temporal. "Technology is based on science and science seems to be boundless," he declared.

"In 1900," he continued, "U. S. industry employed one engineer for every 250 employees. In 1952 this ratio had narrowed to one engineer for every 60 employees and General Electric now has one engineer for every 20 employees."

Mr. Suits also emphasized that, contrary to popular belief, the engineer is not subject to more regimentation as a result of the increasing complexity of engineering practice.

"It is undoubtedly true," he pointed out, "that the efficient pursuit of large research and development projects requires a high degree of co-ordination of the many technical skills."

Neither is the individual scientist and engineer doomed to submerge his individuality into a background of programmed research projects, the speaker declared.

The study of the solid state of matter, for example, is a notable example of research of great importance today with outstanding progress being made by individual researchers and small scientific teams, he explained.

On the other hand, Mr. Suits continued, if ten million dollars are spent to build research equipment, such as a particle accelerator, the scientist cannot expect its research to be a contemplative solitary endeavor.

Two noted leaders of American engineering, T. Keith Glennan, president of the Case Institute of Technology, and John R. Dunning, Mem. ASME, dean of engineering at Columbia University—called on their fellow engineers to take a more active part in politics and business.

Both speakers warned that serious problems facing the country in this atomic age required engineers to make more than their usual contribution in science and technology.

Mr. Glennan, who is on leave from Case to serve as a member of the Atomic Energy Commission, pointed out that there were only three engineers in the 82nd Congress. There should be many more engineer-legislators who would deal effectively with fiscal matters as well as with legislation on atomic energy, conservation, the War Department, and federal construction projects.

Mr. Dunning in his lecture emphasized that the engineer today "must have a broad fundamental scientific background and at the same time have the breadth which extends into problems of executive management, of personnel, and of finance."

Both speakers concurred that engineers should learn to assume top-level management responsibilities in government and industry. Mr. Glennan stated that "the greatest dividends of all will come from moving more engineers with management training and experience into executive positions in the government. This colossal thing that is government today must be managed efficiently from the top on down."

Both state and national governments need the "down-to-earth" approach of engineers who place their "reliance on sound data in terms of men, money, and material," Mr. Glennan declared.

Mr. Dunning, in presenting the thesis that "the engineer has come of age," pointed out that already engineers outnumber all other professions as chairmen of boards or as presidents of leading corporations. "Recent surveys indicate that around 40 per cent of such posts are now filled by engineers, outnumbering considerably both bankers and lawyers," he said. "Decisions in our dynamic economy require broad vision and the engineers are or should be most qualified of any group to make such decisions."

The next industrial revolution is now starting, Mr. Dunning continued. The rapidly increasing use of "energy and machines coupled with the new developments of automatic control operating with servocomputer systems means not only increased production per person but the steady decrease of physical labor and the up-grading of our whole labor group to that of operators who supervise machines which control production. This means another great step in liberating man for higher things.

"Out of this characteristically American revolution, we move toward a social system whose increasing strength and breadth can bring a better life for everyone and demonstrate that the philosophies of Marx are clearly obsolete and decadent."

Mr. Dunning and Mr. Glennan, along with C. Guy Suits, were the three main lecturers at the Centennial Celebration. The two-day anniversary program concluded with a joint meeting of the Yale, Harvard, and Princeton Engineering Societies, and demonstrations of new engineering equipment in the Yale laboratories.

Meetings of Other Societies

Dec. 17
Institute of Aeronautical Sciences, sixteenth Wright Brothers Lecture, U. S. Chamber of Commerce Building Auditorium, Washington, D. C.

Dec. 26–31
American Association for the Advancement of Science, 119th annual meeting, St. Louis, Mo.

Dec. 28–29
The Industrial Relations Research Association, fifth annual meeting, Chicago, Ill.

Jan. 12–15, 1953
American Management Association, general management conference, Hotel Statler, Los Angeles, Calif.

Jan. 19–23, 1953
American Institute of Electrical Engineers, winter general meeting, Hotel Statler, New York, N. Y.

(*ASME Calendar of Coming Events, see page 1045*)

People

H. RUSSELL BEATTY, Mem. ASME, Bedminster, N. J., has been named acting dean, school of engineering, Pratt Institute, by the board of trustees, replacing N. S. Hibshman, who is resigning to accept a position as assistant secretary of the American Institute of Electrical Engineers.

Mr. Beatty, who is licensed as a professional engineer in New Jersey, and maintains offices as a management-engineering consultant in Bedminster, is at present professor and head of the department of administrative engineering at Pratt, whose faculty he joined in 1937.

For the past two years he has been chairman of the Advisory Council of the Educational Testing Service at Princeton University. He is currently a member of the general council of the American Society for Engineering Education, and ASEE's official representative to the Future Scientists of America Program of the National Science Teacher's Association, as well as being active in The American Society of Mechanical Engineers, the New York Personnel Managers Association, and Tau Beta Pi.

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LILLIAN M. GILBRETH, Hon. Mem. ASME, president, Gilbreth Inc., consulting engineers, Montclair, N. J., was recently awarded an honorary DS degree by Lafayette College, Easton, Pa. at the Founders Day exercises.

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JOHN E. LINDBERG, JR., and JAMES W. WHEELER, Mem. ASME, were awarded the Musick Memorial Trophy for 1951 by the Royal New Zealand Aero Club for their joint development of the Sperry engine analyzer, at a luncheon given by the Institute of the Aeronautical Sciences in New York, N. Y., on Oct. 31, 1952.

WILLIAM R. MULLER, Jun. ASME, professor of engineering at the New York University, received the Gilbreth Medal from the Society for Advancement of Management at its annual conference banquet, Oct. 30, 1952, at the Hotel Statler, New York, N. Y. During World War II he was one of the prime movers in developing the job-instructor phase of the outstandingly successful Training Within Industry Program which was adopted by the United States and the United Nations. LAWRENCE A. APPLEY, Assoc. ASME, president, American Management Association, was the recipient of the 1952 Human Relations Award.

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JAMES H. POTTER, Mem. ASME, professor of mechanical engineering at the University of Illinois, has been appointed to the Educator Program of E. I. du Pont de Nemours & Company, Inc., for the current year. Educators are chosen on a national basis to spend 12 months in the engineering department of the du Pont Company to study problems of organization and administration.

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EGER V. MURPHREE, president, Standard Oil Development Company, central research and engineering affiliate of the Standard Oil Company (New Jersey), was named as the 1953 recipient of the Industrial Research Institute Medal.

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C. R. CULLING, president, Carondelet Foundry Company, St. Louis, Mo., was awarded a Gold Medal by the Gray Iron Founder's Society at its 24th annual meeting held in Cleveland, Ohio, Oct. 16–17, 1952. Citations were awarded to JAMES S. VANICK, Mem. ASME, research metallurgist, The International Nickel Company, Inc., New York, N. Y.; JOHN A. CLAUSEN, chief, pig-iron section, iron and steel division, National Production Authority, Washington, D. C.; EDWARD B. SMITH, vice-president (retired), American Brake Shoe Company, New York, N. Y.; and A. J. MCDONALD, chief, ferrous castings section, iron and steel division, National Production Authority, Washington, D. C.

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RALPH L. WILSON, Mem. ASME, director of metallurgy, steel and tube division, Timken Roller Bearing Company, Canton, Ohio, was elected president of the American Society for Metals at its annual meeting in Philadelphia, Pa.

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HERBERT BARNETT, assistant to the president, General Precision Equipment Corporation, New York, N. Y., was elected president of the Society of Motion Picture and Television Engineers.

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FRANK F. GROSECLOSE, Mem. ASME, director, school of industrial engineering, Georgia Institute of Technology, has been granted a year's leave of absence to participate in naval research activities. He will serve as head of the equipment-research department and assist with the organizational problems of the U. S. Civil Engineering Research and Evaluation Laboratories at Port Hueneme, Calif.

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FRED L. PLUMMER, Mem. ASME, director of engineering, Hammond Iron Works, Warren, Pa., has been elected president of the American Welding Society for 1952–1953.

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O. B. J. FRASER, Mem. ASME, assistant manager, development and research division, International Nickel Company, Inc., New York, N. Y., was awarded the Samuel Wylie Miller Memorial Medal by the American Welding Society at its annual dinner in Philadelphia, Pa.

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M. JAKOB, Mem. ASME, department of mechanical engineering, Illinois Institute of Technology, for "Fundamental Studies in Boiling"; and W. L. SIBBITT, Jun. ASME, and G. A. HAWKINS, Mem. ASME, department of mechanical engineering, Purdue Research Foundation, Lafayette, Ind., for "Experimental Determination of Viscosity of Steam Over Wide Ranges of Temperatures and Pressures"; were among the 52 recipients of grants announced by The National Science Foundation.

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REG F. TAYLOR, consulting engineer of Houston, Texas, was nominated for president of The American Society of Heating and Ventilating Engineers in 1953.

Other officers nominated are: First vice-president, L. N. HUNTER, Mem. ASME, vice-president of research, The National Radiator Company, Johnstown, Pa.; second vice-president, JOHN E. HAINES, vice-president, Minneapolis-Honeywell Regulator Company, Minneapolis; treasurer, JOHN W. JAMES, Mem. ASME, vice-president in charge of research, McDonnell & Miller, Inc., Chicago, Ill.

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H. J. TRENKAMP, The Ohio Foundry Co., Cleveland, Ohio, was elected president of the Gray Iron Founders' Society. Among the other officers elected were: T. I. Curtin, Jr., Waltham Foundry Co., Waltham, Mass., vice-president; C. H. Ker, Dalton Foundries, Inc., Warsaw, Ind., secretary; and W. O. Larson, The W. O. Larson Foundry Co., Grafton, Ohio, treasurer.

Student Engineers Honored

Sixth Annual Competition Announced

THE results of the fifth Annual Engineering Undergraduate Award and Scholarship Design Program have been announced by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. Engineering undergraduates in 23 different schools have been given national engineering recognition and awards totaling $5000. Scholarship funds of $1750 have also been awarded to three schools in honor of the first three award winners. Awards were made for the best designs of machinery and structures stressing the value of arc-welded construction.

First Award of $1129 went to Richard Cheverton and Thomas Musslewhite of Georgia Institute of Technology for their joint design of a subcaliber mount for a recoilless rifle. Army officials have expressed interest in the design which permits mounting an 0.22 caliber barrel in a 75-mm rifle for training purposes. In honor of the students, the department of mechanical engineering of Georgia Tech received $1000 in scholarship funds.

Merle Geoffrion, as an undergraduate in the civil-engineering department of the University of Delaware, received the $564 Second Award for his design of a highway bridge. His department received in his honor a scholarship fund of $500.

Third Award of $282 went to Robert Murray, a student in the department of architecture of Rensselaer Polytechnic Institute. His school also was awarded $250 in scholarship funds. Murray made an analysis to determine the economic span length of standard sections.

The program is sponsored annually by the Foundation to encourage engineering students to study the possibilities of arc welding as an engineering tool for improving the quality of machinery and structures of all kinds while reducing costs. The sixth annual competition, now being sponsored, closes on June 29, 1953. All registered undergraduates are eligible to compete.

A. F. Davis, secretary of the Foundation, states that in order to encourage participation by all engineering undergraduates, in whose hands future engineering rests, the rules of the program have been considerably simplified to avoid conflict with regular school work and the restrictions of time. The new-rules booklet is available from The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

ASME Calendar of Coming Events

April 28-30, 1953
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers was Dec. 1, 1952)

May 24-28, 1953
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—Jan. 1, 1953)

June 28-July 2, 1953
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers—Feb. 1, 1953)

Sept. 21-25, 1953
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Chicago, Ill.
(Final date for submitting papers—May 1, 1953)

Sept. 28-30, 1953
ASME Petroleum Mechanical-Engineering Conference, Rice Hotel, Houston, Texas
(Final date for submitting papers—May 1, 1953)

Oct. 5-7, 1953
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(Final date for submitting papers—July 1, 1953)

Nov. 29-Dec. 4, 1953
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1953)
(For Meetings of Other Societies, see page 1043)

ASME Elects Eight Fellows

THE American Society of Mechanical Engineers has honored eight of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men whose outstanding contributions to their profession and to the Society were so honored are:

Alfred D. Blake

ALFRED D. BLAKE, editor of *Combustion*, New York, N. Y., has guided the editorial policy of this magazine so well that power engineers regard it as one of the outstanding technical journals. Its articles have been authoritative and have made major contributions to technical development. Earlier in his career Mr. Blake served with the U. S. Armed Forces in the Ordnance Department, Engineering Division, as captain and later major, during which time he organized the Specification Branch. For 13 years he was managing editor of *Power* and in charge of a staff of 11 editors. After a short period as editor of *Steam Plant Engineering*, Mr. Blake, in 1933 joined *Combustion* as editor. He has written numerous articles for *Power* and *Combustion* as well as reviewed material for other magazines. He is the author of the section on boilers in Marks' "Mechanical Engineers' Handbook," fourth and fifth editions; the section on power in "Chemical Engineer's Handbook," first edition; and wrote the chapters on power for more than ten years in the "New International Year Book." He is also a contributor to "Combustion Engineering" handbook. Mr. Blake, who joined the Society in 1914, has served on many ASME committees including the Fuels Division Executive Committee, the National Nominating Committee, 1939, and the Membership Review Committee, 1945-1947, of which he was chairman. In 1916 he was a member of the Executive Committee, Metropolitan Section and again from 1945-1948, serving as treasurer for two years, and was an ASME representative on the World Power Conference in 1937. In 1937 he acquired a Professional Engineer's license from New York State.

Walter Edwin Bryan

WALTER E. BRYAN, consulting engineer, St. Louis, Mo., spent 40 years from 1907 to 1947 with the St. Louis Public Service Company and its predecessor, the United Railways Company, engaged in furnishing mass transportation for St. Louis and vicinity. From 1913 to 1940 Mr. Bryan was in charge of design and construction of the following major company projects: Change of a major part of the power system from 6600 to 13,200 volts, including transmission and transformer changes to permit the use of 25,000 kw of water power; installation of insulated negative return systems, in collaboration with the U. S. Bureau of Standards; and installation of full-automatic and semiautomatic control in new and existing converter stations. St. Louis was one of the first major cities to install such an extensive system of automatic operation. Mr. Bryan has been in charge of the construction, operation, and maintenance of transmission and distribution systems for 450 miles of track. He has also had charge of such activities as the negotiation of power contracts and the arbitration of wage disputes. From 1940 to 1947 Mr. Bryan was the company's general claim agent, supervising the disposition of claims aggregating approximately $1,250,000 per year. In 1946 he was appointed by the Governor to the Missouri State Board of Registration for Architects and Professional Engineers and currently is chairman of its Engineering Division. He is also executive secretary of the Engineers' Club of St. Louis. During 1947 and 1948 he was associated with Elliott and Porter, consulting engineers of St. Louis. Mr. Bryan has undertaken many civic duties. He has served ASME as chairman of the St. Louis Section and in other capacities.

Fred Harold Daniels

FRED H. DANIELS is chairman of the board of directors, and vice-president, Riley Stoker Corporation, Worcester, Mass., as well as president and director of Badenhausen Corporation, Cornwells Heights, Pa., and secretary and director of A. W. Cash Company, Decatur, Ill., subsidiary companies of Riley. Mr. Daniels has held responsible positions with Riley Stoker Corporation since 1913, conceiving and developing many novel ideas which became important products of the corporation. Since 1926 he has been responsible for the management and direct supervision of all engineering matters including research, design, application, and installation of all types of equipment. He has been actively in charge of the negotiations for the purchase of Riley subsidiary companies. He has had the responsibility for determining that the products made by these companies would be complementary to those already made by Riley, enabling a better coverage of the field as to size, type, and increased ability to burn successfully fuels that were difficult to handle on equipment already made. Mr. Daniels holds many positions of public trust, serving at present as a member of the Industry Advisory Committee of both the National Production Authority and the Office of Price Stabilization. He is a past-president of the American Boiler Manufacturers Association. He holds 14 U. S. Patents. In 1941 Worcester Polytechnic Institute conferred on Mr. Daniels an honorary DE degree.

Harold Sands Falk

HAROLD S. FALK, president, Falk Corporation, Milwaukee, Wis., has played an important part in the industrial apprenticeship movement throughout the country. In addition to building up an effective apprenticeship

system in his own plant, he was chairman of the Apprenticeship Committee of the National Metal Trades Association in Milwaukee for ten years. Under his direction the number of apprentices in the city's metal-trades industries grew from about 400 in 1920 to about 1400 in 1940. He is the originator of the Milwaukee Plan of Apprentice Training which assumes that manufacturing industries have a joint responsibility to train a proper quota of mechanics for an industrial community. With the Falk Corporation since 1900, Mr. Falk, in 1926, undertook the first attempt in the gear industry to standardize and catalog a line of speed reducers. In 1938 he became director of engineering and today still counsels the engineering staff on product and tool and jig design. In addition to his work with the Falk Corporation, he is on the board of directors of several other companies and is executive vice-president of The Heil Company of Milwaukee. He has done much good civic work for the city of Milwaukee and was a civilian aide to the Secretary of the Army for Wisconsin for 20 years. Mr. Falk was a member of the ASME Committee on Education and Training. In 1948 he received an honorary LLD degree from the University of Wisconsin.

Earl Downing Hay

EARL D. HAY, professor, mechanical engineering, Iowa State College, Ames, Iowa, has made his greatest contribution in the field of engineering education, as a teacher, as an administrator, in scientific research, and in engineering service. As dean of the college of engineering, Des Moines University in 1920, he organized the engineering college in a new university. He was the first dean of the college of engineering, University of Wyoming, where he also had organized the college. From 1928 to 1946 he headed the departments of mechanical and industrial engineering at the University of Kansas. While there he organized the department of aeronautical engineering, designed and supervised construction of a large wind tunnel for research, and was the co-ordinator of the civil pilot-training program. Professor Hay has also done much work in the fields of design and invention, developing many special automatic devices. He has been active in engineering-society affairs. He helped to organize the Wyoming Engineering Society and to secure the enactment of the Registration Law. Professor Hay was the state delegate of Kansas to the World Power Conference in 1936. He was a member of the Kansas Registration Board for Professional Engineers from 1939 to 1946, in charge of examinations, and served as secretary of the board for two years. He has lectured on engineering education over Radio Station KFKU. For ASME, Professor Hay organized the Student Branch at the University of Wyoming, and, among other services, served as chairman of both the Kansas City and the Central Iowa Section. He is the author of several papers and has contributed chapters to "Trade Foundations" and "Education Through Woodworking."

Burton Cowles Mallory

BURTON C. MALLORY, chief mechanical engineer, Stone and Webster Engineering Corporation, Boston, Mass., as chief of one of the world's largest and most versatile organizations for the design of the mechanical features of steam-power generating plants, has made outstanding contributions to the art of power generation. Mr. Mallory directs the work of about 80 engineers on design for construction of steam-power stations with 2½ million kw capacity, with capacities in various stations from 5000 kw to 250,000 kw, and reports on industrial and utility installations with many different fuels. Mr. Mallory has worked in the steam-power field for over 30 years, joining his present company in 1937. From 1937 to 1947 in the company's Chicago and Boston offices he wrote 45 steam and power reports for 30 different public-utility and industrial clients and worked on design of plants ranging in size from one 65,000-lb per hour boiler to two 60,000-kw units. In 1947–1948 he supervised the work of several installations including two 60,000-kw turbine generators for Southern California Edison Company and two 40,000-kw units for Gulf States Utilities Company. He is the author of several papers on steam-power stations.

Joseph Pope

JOSEPH POPE, first vice-president and consulting engineer, Stone and Webster Engineering Corporation, New York, N. Y., has advanced the science of engineering by contributing during a period of rapid expansion to the design and practical operation of power stations, incorporating steam and electric units of ever-increasing capability as parts of systems of greater capacities. In his earlier work in the betterment of station operating procedures and in research engineering, Mr. Pope developed operating techniques, designs, and arrangements which made it practical to build and operate power stations made up of units of greatly increased ratings and higher efficiencies. His more recent consulting engineering work with engineers and executives of many utilities and industrial organizations in this country and abroad in the planning of stations and power systems for the expansion of major projects has been a large factor in the tremendous growth of the electric-power industry. Mr. Pope and his staff developed much of the technique now used in predicting performance of steam-power stations. He made many studies and reports on power matters and economics. Mr. Pope is now responsible for top-level engineering design in originating or developing further public utilities and many major projects. His ASME activities include service on the Finance Committee and as ASME representative on the International Relations Committee of Engineers Joint Council.

David Burr Porter

DAVID B. PORTER, professor of industrial engineering, New York University, New York, N. Y., has made outstanding contributions to the science of industrial engineering by his teaching, in the development of techniques and laboratories in motion study, and by his lectures and consulting work both here and abroad on the subject of which he is a recognized authority. Professor Porter was a coworker of Henry L. Gantt in the field of scientific management and in 1940 he was awarded the Gilbreth Medal by the Society for the Advancement of Management for his work in this field. He joined New York University in 1923 and in 1928 organized the first university-laboratory course in motion study. For the past few years he has been conducting work-simplification round tables for executives in industry and commerce. He has been on the teaching staff and director of laboratories of the annual Work Simplification Conference at Lake Placid, N. Y., for many years. In 1942 he brought about the application of motion study to coast-defense guns in coast artillery schools and later made motion-study analysis of the three-inch naval gun. In 1948 he was given a plaque of honor by the Swedish Society of Engineers. He has done much work on research committees.

He is the author of Section 3, "Management Handbook," 1924; Section 8 on work simplification and motion study for "Production Handbook," 1944; and numerous papers.

UNESCO'S Montevideo Center Helps Science to Help People

IN A small house on Boulevard Artigas, near the center of Montevideo, Uruguay, a handful of people are helping bring together and put to use the work of thousands of scientists in Central and South America. This work, by UNESCO's Science Co-Operation Office for Latin America, is an important element in continent-wide efforts to raise the living standards of the people. Under the direction of Dr. A. Establier, efforts, demands, and activities are co-ordinated; isolated scientific workers are connected with fellow researchers in distant lands, and a variety of other services are provided.

Requests which arrive daily are varied and sometimes exotic, but there is almost always a tangible, practical purpose, closely affecting the well-being of the people.

Exchange of information, the supply of microfilms, bibliographies of scientific material, keeps one section of the Center busy. Another deals with publications. Since its establishment, the Center has published 13 volumes and several more are in preparation. Principally bibliographies of scientific publications in the different Latin American countries, they have been of great use to scientific institutions.

Of great value too are registers of scientists, and brochures giving a summary of the state of various sciences in Latin America. The first volume of this series, on chemistry, appeared last May, and one on mathematics has been published since.

The Center's card-index system, with 15,000 entries already, and constantly expanding, records not merely the names and particulars of scientists and institutions, but gives also details of their particular field of activity. To a more limited extent, such co-operation is also aided by the Center's growing library.

The Center's efforts to stimulate and develop scientific progress are also directed to the layman. An example of this was the recent mobile scientific exhibition, prepared by UNESCO in collaboration with the Massachusetts Institute of Technology, dealing with astronomy, mechanics, heat, sound, optics, electricity, electronics, and nuclear physics dramatized by photos, scientific apparatus, and working models.

The exhibition was presented in Lima, Quito, Guayaquil, Havana, and Mexico, and has more recently toured the Central American Republics.

One of the Center's boldest steps was taken with the establishment in Morococha, Peru, of a Center for High-Altitude Physics. An international experimental station was founded over 14,500 feet above sea level, in collaboration with the Institute of Andean Biology.

More recently, UNESCO's Technical Assistance Program has imposed new responsibilities on the Center which has helped negotiate Technical Assistance agreements with a number of Latin-American governments.

UNESCO's Montevideo Center exercises a stimulating and encouraging influence on the scientific activities of the Latin-American continent and has contributed to activities which will lead to betterment of the daily lives of tens of millions of people.

Coming Meetings

Nuclear Physics Conference

THE National Science Foundation and the University of Rochester will sponsor an international conference on high-energy nuclear physics at Rochester, N. Y., Dec. 18–20, 1952. The conference will be financed by a $2000 grant from the National Science Foundation and contributions from several Rochester industrial firms.

The conference will bring together about 70 nuclear physicists from the United States, Canada, and Mexico to discuss recent research findings on high-energy particles and to plan future studies in this field. Investigation of high-energy particles is one of the most active research areas in physics at the present time. Such research is of fundamental importance in the release and utilization of atomic energy. The three-day session will consider such topics as new unstable particles, meson production, and saturation of nuclear forces.

Protective Coatings Symposium

TITLES of the five papers that will make up the Protective Coatings Symposium at the National Association of Corrosion Engineers' meeting in Chicago, Ill., March 16–20, 1953, have been announced. The titles are as follows: Coating research and application in atomic-energy operations, investigation of protective coatings for high-temperature underground pipe lines, nature and theory of filiform corrosion, effects of composition of steel on the performance of organic coatings in atmospheric exposure, and weld-seam and weld-flux effects on coating life.

The 1953 Chicago meeting will be the ninth annual meeting of the National Association of Corrosion Engineers, an international engineering association devoted to controlling corrosion and deterioration of metals and other materials.

Literature

Weldability of Metals

A 141-page book, explaining factors determining weldability, gives causes and cures for hard-to-weld metals; details welding procedures for steels, nickel, iron, alloys, copper, aluminum, and hardfacing. Reprinted from the Ninth Edition of the Procedure Handbook of Arc Welding Design and Practice. Publisher, The Lincoln Electric Company, Cleveland 17, Ohio. Price, 50 cents in U. S. A.; 75 cents elsewhere, postage paid.

Diesel-Engine Lubricating Oil

"SPECTROGRAPHIC Analysis of Diesel Engine Lubricating Oil," published this week by American Locomotive Company of Schenectady, N. Y., tells in 78 pages of text and photographs how the spectrograph—a scientific instrument that can detect exceedingly small amounts of chemical elements in any substance—is now being used by Diesel-locomotive engineers to control engine maintenance and prevent costly breakdowns.

The new publication presents a carefully edited transcription—based on on-the-spot tape recordings—of nine technical papers delivered at a symposium sponsored by American Locomotive last spring, attended by 86 representatives from 43 railroads in all parts of the United States and Canada. (See MECHANICAL ENGINEERING, August, 1952, p. 659.) These papers, complete with tabular data, case histories, and pictures, show how the spectrographic method has been adapted to Diesel-locomotive maintenance by leading railroads, together with Alco's own experience in extending this new scientific technique on a broader scale.

Heat Transfer and Fluid Mechanics

AVAILABLE now are preprints of papers of the 1952 Heat Transfer and Fluid Mechanics Institute held June 24–26, 1952, at the University of California, Los Angeles.

Twelve stimulating discussions of the latest scientific contributions of research and development centers throughout the United States—all the papers were selected and reviewed by engineers engaged in related work and by the sponsoring institutions: California Institute of Technology, University of California, Stanford University, Santa Clara University, and the University of Southern California.

The papers are contained in a paper-bound book of 186 pages, 8½ × 11 in., three-hole punched, and sells for $4.

50-Year Index to ASTM Technical Papers and Reports

THE 50-Year Index provides a detailed author and subject index to all the ASTM technical papers and reports dealing with materials, particularly their properties and testing, appearing in ASTM publications covering the period from 1898 through 1950. From 1898 to 1902 the Society was known as the American Section of the International Association for Testing Materials. In 1902 the Society obtained its charter and was reorganized as the American Society for Testing Materials.

The index is concerned basically with technical papers which have appeared in Proceedings, *ASTM Bulletin*, Special Technical Publications, or special compilations of standards. In addition, a number of technical reports have been referenced which, while not credited to a specific author, nevertheless provide worth-while data and information which should be considered when searching the available data in ASTM publications on a specific subject. Many of these reports are the result of co-operative effort in technical committees.

Certain innovations are embodied in this Index; for example, the author index which precedes the subject listings gives the complete titles of papers and items covered. This makes it possible to present the subject index, by far the major portion of this publication, in a condensed and easily usable form.

The subject index includes hundreds of headings, and every paper or report referenced is listed under the major subjects and materials discussed. There is a separate condensed subject index listing all of the technical symposiums.

Copies of this 216-page publication, in red cloth binding, 6 × 9 in. page size, can be procured from ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa., at $6 per copy.

Education

Tool Engineering Research Foundation Announced

ESTABLISHMENT of a national Tool Engineering Research Foundation to carry out scientific research projects in the fields of manufacturing, manufacturing processes, and allied tool engineering subjects was assured in Buffalo, N. Y., Oct. 11, 1952, with the election of the first five trustees, among whom was L. F. Polk, Mem. ASME, of the Foundation by the board of directors of the American Society of Tool Engineers, sponsors of the project.

The Foundation was chartered as an independent nonprofit scientific research organization at a meeting held in the ASTE building in Detroit, Mich., Oct. 28, 1952.

Tentative plans call for making use of industrial laboratories, colleges, and universities throughout the nation for the carrying out of research projects. $75,000 has been ap-

propriated by the ASTE itself as an initial contribution to assist in the establishment of the sorely needed Foundation.

Additional trustees of the Foundation will be elected by the board of directors of the ASTE until a total of 15 is reached. The trustees will have no specific tenure of office, according to L. B. Bellamy president, ASTE. The chairman of the board of trustees of the ASTE Research Foundation will be elected by the board of directors of the society at a later date.

Gaillard Seminar

JOHN GAILLARD, Mem. ASME, mechanical engineer on the staff of the American Standards Association, and lecturer at Columbia University, will hold his next five-day private seminar on industrial standardization from Jan. 26 through Jan. 30, 1953, in the Engineering Societies Building, 29 West 39th Street, New York, N. Y.

The Gaillard Seminars were started in 1947 upon request from companies for assistance in the organization of their standardization work and the training of their men in writing standards specifications. The total attendance so far has been 158 representatives from 98 organizations. The average seminar group has consisted of 14 men.

The January, 1953, session will consist of ten conferences, one in the morning, 9:30 to 12:00, and one in the afternoon, 1:30 to 4:00, Monday through Friday. At each conference a subject on the seminar program will be presented by Dr. Gaillard and then discussed around the table.

For further details and registration write to Dr. John Gaillard, 400 West 118th Street, New York 27, N. Y.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Oct. 28, 1952

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Oct. 28, 1952. R. J. S. Pigott, chairman, presided. In addition to Mr. Pigott there were present: H. R. Kessler, T. E. Purcell, R. A. Sherman, and W. F. Thompson of the Committee; E. J. Kates, assistant treasurer; F. S. Blackall, jr., president-elect; E. G. Bailey, past-president; C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary. The following actions were of general interest:

1952 Regional Delegates Conference

The Executive Committee voted to adopt the statements of the Council on the recommendations of the 1952 Regional Delegates Conference. Copies of these statements are available on request from the ASME Secretary.

1952 Annual Meeting

It was decided to make the usual Sunday evening program during the Annual Meeting into an open meeting of the Council devoted to the subject "How Can the Society Be of Greater Service to Its Members?" Invitations will be issued to Council members, Council members-elect, members of Standing Committees, Professional Divisions executive committees, and Section executive committees.

Student Branches

The petition to establish a student branch at the Evening Division of the College of the City of New York, New York, N. Y., was approved.

It was also voted to request the establishment of a student branch at McGill University, Montreal, Can.

Certificates of Award

Certificates of Award were granted to the following retiring chairmen of Sections: Robert W. Mills, Nebraska; William S. Major, Pittsburgh; Elvin T. McDivitt, Susquehanna; and L. Alvin Chase, Waterbury.

Certificates of Award were also presented to the following committeemen of Region IV: L. B. Jones, secretary, Region IV; Edward E. Williams, chairman, Membership Development Committee; Paul R. Yopp, chairman, Civic Responsibility Committee, and B. E. Sherrill, Regional Delegate to National Regional Delegates Committee.

Postcollege Training Program

L. F. Grant, chairman, ECPD, sent a communication expressing appreciation for the Society's contribution for the support of the Cincinnati training program, now being initiated. At the request of Colonel Grant, the Secretary was authorized to request wholehearted co-operation in the program by the Cincinnati Section of ASME.

EJC Constitution

The Council, at the Cincinnati Meeting, June, 1952, authorized the President and the Secretary to transmit the approval of the Society to EJC for a change in the EJC constitution, providing that the number of representatives of ASME would be changed from the present three to one representative per 10,000 voting members, or major fraction thereof, with the stipulation that this change in the constitution would not be made unless four additional societies accepted the invitation to join EJC.

In the interest of making the constitutional change before Jan. 1, 1953, the Committee voted that ASME is agreeable to the proposed change in the EJC constitution without the requirement that any additional societies join EJC.

Presidential Appointment

The following presidential appointment was approved: A. W. Luce as ASME representative to the New York Safety Council, 1953 Annual Convention and Exposition.

Junior Forum

Conducted by Joseph Schmerler[1]

National Junior Committee Seeks Active Junior Members

JUNIOR members of ASME often ask about the activities that the Society sponsors for them. This implies that the Society should cater specifically to the Junior segment of the membership. The Society only differentiates between members according to the dues they pay, not in the degree of allowable participation. However, since Junior problems and interests are also Society problems and interests, and as such should be heard, a National Junior Committee has been formed to aid in treating these questions.

As part of the work, the Committee also proposes to eliminate a complaint, sometimes heard, that Juniors find it difficult to "break in" to active society participation. In the process of establishing contacts in the various Regions, the Committee offers the perfect method for becoming active in the Society.

A number of questions have been raised as to the "hows," "whys," and "wherefores" of Committee function and the positions of "Corresponding Members" which the Committee is seeking to fill. In answer to these questions, Andrew J. Snyder, the chairman of the National Junior Committee, has prepared a statement as to the aims and method of the entire program.

Mr. Snyder states that the purpose of the Committee is to recruit Corresponding Members who will receive copies of Committee correspondence and submit their opinions on questions and problems which the Committee must settle. It is hoped to develop among this group a nucleus of Juniors who, according to the amount of initiative exhibited, could be selected as actual members of the Committee to represent truly the more than 22,000 members of the Society who are classified as Juniors under the age of 33 years.

Mr. Snyder states further in outlining the activities of the Committee that meetings of the National Junior Committee are held on an

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

average of six times a year, on Saturday, so as to interfere as little as possible with business. These meetings are conducted at Society Headquarters in New York, N. Y. Meetings usually last about six hours depending upon the number of Agenda items.

The subjects on the Agenda cover items of interest to the younger membership. It is the responsibility of the Committee to conduct sessions devoted to the Professional Development of the young engineer at the various national meetings of the Society; to encourage the local Junior membership to greater participation in their local Section affairs; to solicit comment and distribute information on subjects of interest to men starting their careers; to contribute to the Junior Forum for publication in MECHANICAL ENGINEERING as a vehicle of the young engineer's aspiration; and to be of service to the Society in whatever capacity the Council may designate.

The National Junior Committee is responsible for giving expression to the feelings and opinions of the Junior Members of the Society. It is the only committee that has as its sole responsibility the task of representing young mechanical engineers before the profession's technical society.

The Committee, only this year, has been acknowledged as a standing committee of the Society. Its by-laws have recently been approved and must, therefore, be flexible. Committee members are appointed for a five-year period. However, it is understood that these appointments are subject to the dictates of commercial life. Young men, especially, are prone to change in their early years of employment; therefore the term of office is anticipated only.

Local Sections do not appoint representatives to the National Junior Committee any more than they do to other committees of ASME. The appointments are made by the Council upon recommendation of the Committee. The recommendation is dependent upon the activity exhibited and the manner in which a Corresponding Member of the Committee carries out an assignment of the Committee. When sufficient interest and ability has been exhibited an invitation to sit with the committee will be issued by the chairman.

In answering the question "Of what value will these meetings and Committee work be to the engineer and his company?"—we can only reply, "It's up to You." Every successful engineer has been active in the professional society representing his particular field of endeavor. The greater the activity, the greater the so-called reward for both engineer and company.

The ASME is a nonprofit technical organization and as such is limited in funds. The Old Guard Committee, made up of members no longer required to pay dues, has underwritten the expenses of Junior delegates attending the various national meetings throughout the country as an inducement to young engineers not fortunate enough to have company backing. It has also, from time to time, contributed to transportation costs of members of the committee who could not obtain company funds for travel purposes. It is desired, for obvious reasons, that this type of expenditure be kept to a minimum. Company sponsorship is, therefore, encouraged wherever possible. We want to emphasize that outstanding ability, as exhibited locally, will be sought out and utilized regardless of company affiliation. Our purpose is to obtain dynamic young leadership wherever it is to be found. The National Junior Committee is interested in hearing from Juniors who wish to become corresponding members of the Committee. There exists a standing invitation for their participation. All that a Junior need do is write to the Junior Forum, Editorial Department, MECHANICAL ENGINEERING, state his intention, and give a slight introduction to his background.

ASME Standards Workshop

Screw Threads

SECTIONAL Committee B1 on Standardization and Unification of Screw Threads, met on October 8 to consider ASA B1.1-1949 which is due for its trienniel reaffirmation or revision. In view of the fact that this standard, the provisions of which are uniform with those in the applicable British and Canadian standards, has undergone three printings since its initial approval, with various typographical and editorial corrections, and since a simplification of format seems desirable in order to make the standard easier to use, the committee agreed to appoint an editorial committee to prepare a new edition of B1.1 incorporating technical changes already approved and to simplify it editorially.

Reports were received from the leader of the American delegation to the ABC and ISO Conferences. In connection with American, British, and Canadian unification, it was noted that the change in the half-inch size coarse series thread to 13 threads per inch was formally confirmed. Considerable discussion was held concerning the problem of holding tolerances with plated and coated threads. The British and Canadians accepted for study the American standards on Stub Acme and Centralizing Acme Threads. On the whole it was felt that good progress toward accord had been made and a further ABC Conference has been scheduled for early 1953.

In connection with the International Standards Organization Screw Thread Conference held the following week, Sectional Committee B1 was represented by a delegation totaling 17, both representatives and consultants. While no formal proposal was accepted concerning a series of diameter-pitch combinations to effect interchangeability, indications were that in all probability a single series in metric measure will be presented to the member bodies for consideration. Since the U. S., through Sectional Committee B1, has at the present time "observer" status on TC1, the question was brought before B1 as to whether or not the Committee should take under advisement again the problem of its degree of participation in this project, and the Committee took action to give this further study with a view to determining a long-range position.

Bolts and Nuts

The Subcommittee in charge of the development of the standard on Square and Hexagon Bolts and Nuts met on October 10 at the Engineering Societies Building, to consider suggestions that had been made for improvement in the standard subsequent to its publication in April, 1952. It was agreed that when the standard is revised the minimum body diameter of heavy finished hexagon bolts should agree with that specified for finished bolts. Numerous other refinements were agreed to for the next edition of the standard which will not effect interchangeability with the presently Unified sizes.

Machine Screws

The Subcommittee in charge of the development of a proposed revision of the standard for Machine Screws met on October 9, 1952, and received a detailed report of the work which has been done by a subgroup that has been investigating characteristics of tapping screws. This subgroup reported progress but indicated the need for co-ordination of type designations among the several industries and government services. It was brought out that under certain conditions, with certain materials and in certain applications a finer than standard pitch is necessary on short screws and this question was referred back to the subcommittee for further study.

A torque testing machine, whereby the ultimate torque strength of a screw can be determined by the use of a torque wrench, was exhibited to the subcommittee. Members were given the opportunity of familiarizing themselves with the various features of this machine by personal operation and, in their opinion, its speed and simplicity for testing was a decided forward step.

The Subgroup on Tapping Screws was instructed to continue its work in developing specifications for inspection and testing purposes.

Surface Finish

Following the publication of B46.2-1952, the Sectional Committee on Surface Finish authorized the formation of three subcommittees to consider specification of widths and definition of the terms in the specification, revision of Surface Roughness and Lay, ASA B46.1-1947 and specification of standard instrument characteristics. All three subcommittees held meetings early this fall and outlined the program of work before them. It appeared that some overlapping of jurisdiction was impending and therefore the chairman has created an Executive Committee which will include the chairmen of the three subcommittees to insure that no duplication of work will transpire.

Pressure Piping

The Executive Committee on Code for Pressure Piping met on October 24 and tenta-

tively approved several changes to be made in the code. These, provided that they receive the approval of the Sectional Committee, will form the basis for a revision of B31.1-1951. In particular, the joint efficiencies for various types of welded pipe adopted in the several sections of the code received careful scrutiny and it was decided to establish liaison with the Boiler Code group which has these joint efficiencies under consideration, in an effort to bring the two codes into line.

Since several states and provinces of Canada have adopted the code in whole or in part as minimum safety requirements for use in their area, the committee voted to establish a group of conferees to be appointed by the administrative authorities of the legislative areas that have adopted the code. This group will receive notices of meetings and copies of minutes and thereby provide the administrative authorities with a contact with the B31 committee. The first of these conferees, Elmer C. Nuesse of the Connecticut Public Utilities Commission, was present at the meeting and expressed appreciation for the opportunity afforded by this action to observe the committee's work. In his opinion, such a group will be mutually helpful to the committee and to the administrative authorities.

The committee received copies of Section 8 on Gas Transmission and Distribution Piping Systems (see October issue of MECHANICAL ENGINEERING, page 856) which has finally been approved by the American Standards Association with the designation ASA B31.1.8-1952.

The committee also was advised of the newly revised Section 9 of the ASME Boiler and Pressure Vessel Code covering welding qualifications and voted to adopt its provisions for fabrication work under the Code for Pressure Piping.

All subcommittees of the Sectional Committee charged with the development of specific sections were requested to undertake a review of their sections for an early proposal of a new edition to the code.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York, 8 West 40th Street | Chicago, 84 East Randolph Street | Detroit, 100 Farnsworth Ave. | San Francisco, 57 Post Street

Men Available[1]

Sales and Development Engineer, 38, married, mechanical engineer, experienced in aluminum and steel-container development, sales, and production. Also aluminum-foil thermal insulation. Would be valuable in directing plastics-container program. Presently available. West Coast preferred. Me-919-395-D-21.

Mechanical Engineer, 54, BSME, 30 years' practical and technical experience in plant engineering and administration, responsible for research and development, design of special tools and machines, broad ideas in the application of modern methods, original ideas which have been tried and proved successful, cost conscious; interesting background. Available six to eight weeks after agreement reached. Prefers nonmetropolitan New York. Me-920.

Construction Engineer seeks connection with process industry. M.I.T. graduate, capable assuming full charge expansion operations, 15 years' industrial design and construction experience, now department head. Me-921.

Positions Available

Assistant Chief Engineer, 35–40, to assist in the operation of power plant, air-conditioning plant, and pipe shop. Should be thoroughly familiar with power-plant engineering and write clear reports and memorandums. Mechanical engineer desirable, but not essential. Must have some technical schooling and have a New York City Stationary Engineer's license and Ice Machine Permit. At least ten years in actual operation of boiler and engine-room equipment. $6000–$6500. New York, N. Y. Y-7709.

[1] All men listed hold some form of ASME membership.

Engineers. (*a*) Assistant general manager, 40–55, to assist president and to take complete charge of manufacturing and accounting functions of company engaged in paper and board business. $15,000–$20,000. (*b*) Personnel director, 35–45, with experience in job evaluation, wage administration. Must be able to negotiate union contracts with seven unions for all hourly and salaried employees. $7500–$8500. New York, N. Y. Y-7717.

Engineers. (*a*) Controller to take over all accounting and fiscal matters for company with numerous plants in the process industries. $10,000. (*b*) Purchasing engineer, 24–32, with three to five years' experience in purchasing heavy-equipment and factory supplies for manufacturer. $6000. New York, N. Y. Y-7718.

Industrial Engineer, two to three years' experience on time and motion study in tool or heavy-machine industry. $6000–$7500. New York, N. Y. Y-7722.

Liaison Engineer, experience in the molded plastics field, some knowledge of steel molds. Will act as liaison between the sales, customer, and production department for manufacturer of this type of mold. $8000–$10,000. Pa. Y-7726.

Shop Superintendent, previous experience in metalworking industry. Knowledge of stampings, welding, assembly, and finish operations required. Salary open. Mich. Y-7730-D-8052.

Assistant Plant Superintendent, considerable experience in production of small metal-goods items such as assembling, stamping, plating, polishing, etc. $7500. Northern N. J. Y-7733.

Engineers. (*a*) Machine designer, mechanical graduate, ten years' experience in machine design. Should be capable of initiating original designs and translating them into detailed drawings with proper tolerances for manufacturing. Should be well versed in mechanical linkages, calculations of stresses and drive methods such as gears and chain. Will do 80 per cent of the detailing of drawings, at least for the first year. $6000–$8000. (*b*) Instrument engineer, graduate, with ten years' experience in varied application work. Should be able to analyze customer's specifications and apply the proper control components to the manufacturer's standard pumps. Knowledge of electronic, chemical, and mechanical controls for the automatic proportioning and ratio control, pH control, temperature, pressure of conductivity control. Half of time will be on the drafting board making sketches showing the systems to be used with quotations and also over-all layouts for shop construction $5000–$6500. Pa. Y-7746.

Mechanical Engineer, 35–50, minimum of five years' experience in the design of instruments, mechanisms, and servo systems. Will be group leader. $8000. New York, N. Y. Y-7754.

Project Engineer, mechanical graduate, to prepare plans for new construction and installation of machinery and equipment in cement mill. $5400. Ohio. Y-7758.

Engineers. (*a*) Project engineers, preferably with minimum of five years' experience in aircraft engines, with some knowledge of development and design of new parts, procurement of materials, and will be required to schedule activities through the shop. $7500–$8500. (*b*) Assistant project engineer with experience as afore-mentioned. $6500–$7200. (*c*) Liaison contact engineer, minimum of three years' experience in liaison or production co-ordination between engineering and manufacturing in reciprocating aircraft-engine manufacture. Will initiate drawings and specification changes, etc. $6500–$7500. Conn. Y-7759.

Engineers. (*a*) Plant manager for multiplant operations for company manufacturing roofing felt, asphalt roofing, and related products. $10,000. (*b*) Chief engineer, to 50, mechanical, chemical, or electrical engineer with knowledge of nonmetal multiplant operations, preferably in building-materials manufacture such as asphalt roofing. Will be responsible for the proper maintenance of all equipment. $8000–$9000. (*c*) Industrial engineer, young, industrial, chemical, or mechanical, with similar knowledge as aforementioned, for maintenance of performance charts and logs using reports obtained from operating departments as well as laboratory and accounting departments reports. $5000–$6000. Midwest. Y-7760.

Engineers. (*a*) Methods engineer, young, mechanical graduate, industrial-engineering experience covering work simplification, methods, and production for metal-products manufacturer. (*b*) Tool engineer, 30–40, toolmaking experience covering tools, jigs, and fixtures for bench work, modelmaking, and assisting production engineer. $5000–$6000. New York metropolitan area. Y-7774.

General Manager, 35–45, engineering graduate, executive, production, and accounting experience covering electronic and electromechanical devices for small manufacturer of ordnance and aircraft accessories. $8000–$10,000, plus bonus. Long Island, N. Y. Y-7775.

Mechanical Engineer, college education or equivalent and three or four years' responsible experience in a large plant-maintenance and engineering organization. Will be responsible for the design and estimates for all revisions to interior ventilating, air-conditioning, and refrigeration systems. Should have good knowledge of the preparation and review of preventative maintenance schedules as related to heating, ventilating, air-conditioning, and refrigeration systems. Ability to prepare drawings, sketches, and/or specifications for standard practices; inspection of construction in conjunction with distribution lines and supervision on an engineering level of steam-maintenance crews. Salary open. Upstate New York. Y-7779.

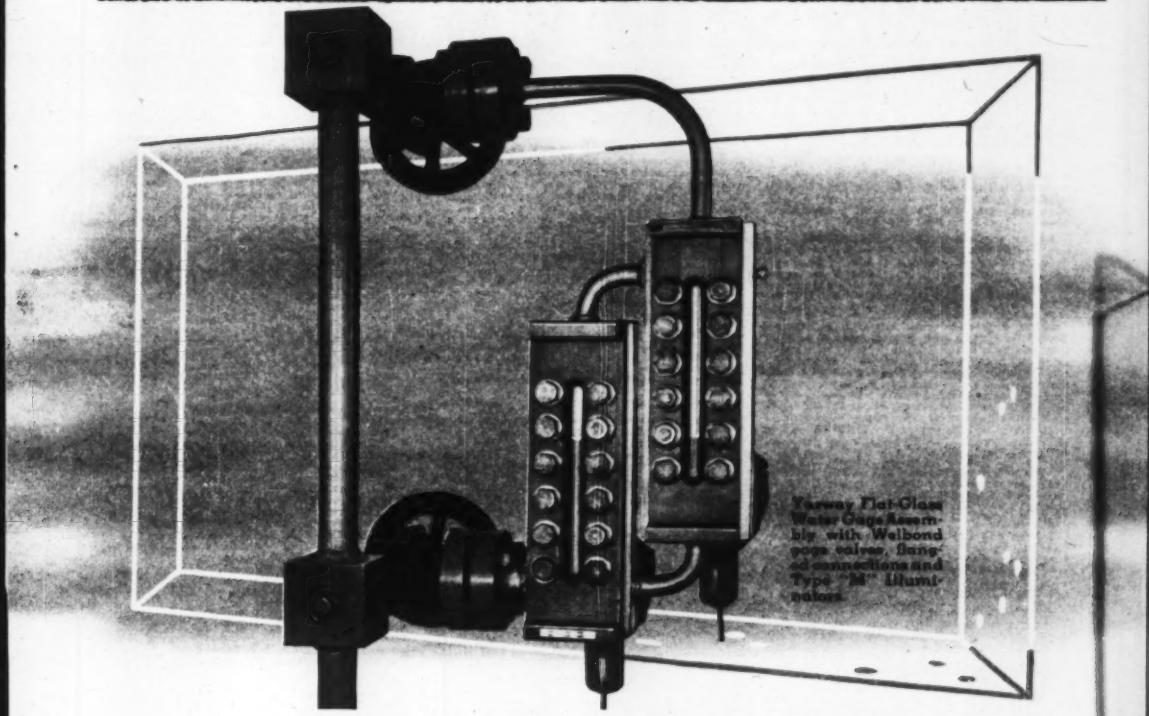
Chief Engineer, 30–40, executive ability and considerable experience in machine design, preferably in the automatic packaging or paper-converting field. $12,000. Conn. Y-7785.

Mechanical Engineers to engage in design, development, and testing of automatic aircraft guns, feed mechanisms, and associated devices. One should have exceptional mathematical ability to apply it to mechanical problems involving impact, sudden accelerations, vibrations, etc. Company does product-development work for civilian clients in various fields and also for the U.S. Government in the field of ordnance development. Salary open. Conn. Y-7794.

(*ASME News continued on page 1052*)

What's New

IN BOILER WATER LEVEL INDICATION?



Yarway Flat-Glass Water Gage Assembly with Welbond gage valves, flanged connections and Type "M" illuminators.

NEW *SEPARATED-DESIGN* WATER GAGES

This new Yarway water gage assembly has been developed to meet the demands for greater dependability, longer life, and more accurate readings in high pressure service.

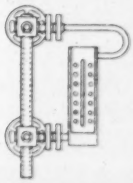
The gage glass inserts are of the Yarway pressure-sealed "floating assembly type". Yarway Welbond gage valves are used. Greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops (see above).

The short connection to the drum assures greater accuracy of the gage reading, and the lower flanged connection eliminates a stuffing box. The upper flanged loop connection between the insert and gage valve allows expansion and contraction of the various components.

The tie bar-type water column linking the gage valves provides circulation to keep gage nearer drum temperature.

Yarway Type "M" Illuminators on the gage inserts cause the meniscus at water level to "shine like a star". This illuminator is especially effective in penetrating deposits on gage glass, dust particles in air and extraneous light.

For full information, write for Yarway Bulletin WG-1811.



Yarway Single Insert type gage for medium range of visibilities.

YARNALL-WARING COMPANY • 108 Mermaid Avenue, Philadelphia 18, Pa.

Branch Offices in Principal Cities

YARWAY *STEAM PLANT EQUIPMENT*

Mechanical Engineer, about 35, experienced in design work, including problems involving rapid combustion or propellent work. Company manufactures industrial piercing and driving devices actuated by explosives. Will engage in design, development, and manufacture of these devices and will ultimately head up the project with full responsibility for its work and the supervision of ten to twenty persons. Salary open. Pa. Y-7802.

Managing Director, experienced, ability to take charge of modernizing the ammunition-manufacturing departments of an arsenal, in which ammunition and field-artillery ammunition are produced. The arsenal makes the metal parts only. Should be able to organize the means to produce cast and forged or pressed projectiles, steel cups, fuses, primers, etc. Knowledge of Portuguese or Spanish desirable. Salary open. Duration, one or two years or longer. Portugal. Y-7803.

Mechanical or Industrial Engineer, some experience in time and motion study, as well as estimating for machine-shop products. Should have some practical cost-accounting experience. $5940. New York, N. Y. Y-7805.

Engineer, graduate, over 26, who has had a few years' industrial experience, to work in standards department of an engineering society on specifications, standards, etc. Must have good personality as he will contact manufacturers, etc. $5000 to start. New York, N. Y. Y-7806.

Industrial Specialist, aeronautical or mechanical degree or equivalent in experience. Should have experience solving complex production problems in the field of planning and scheduling and broad understanding of problems relative to engineering changes, critical materials, and machine tools. Equal experience in industrial-engineering consultant work also acceptable. Will serve as a member of the advisory staff of the director of procurement and production, providing advisory service in the entire field of industrial-mobilization planning program. $12,000. Ohio. Y-7809.

Designer, mechanical graduate, at least five years' office-machinery design experience, to design high-speed tabulating and printing machines. $8000–$10,000. Brooklyn, N. Y. Y-7810.

Design and Layout Engineers, under 45, mechanical degree or equivalent with five or more years' experience in the design and layout of off-the-road, heavy-duty trailer and truck-bodies used in quarrying, mining, and earthmoving operations. Salary open. Pa. Y-7811.

Assistant Chief Engineer to fill a top engineering job as administrator, research and development engineer for a group of 300 engineers doing advanced research and special projects in the automotive and aeronautical field. $30,000–$35,000. West Coast. Y-7821.

Vice-President in Charge of Operations, 35–45, for a relatively large, rapidly expanding developer manufacturer of automatic machinery used by industry for many diverse purposes. Will be responsible for all operations of company with exception of finance, research, and development. Should possess a broad technical background in evaluating manufacturing facilities and their potential, either in the chemical, rubber, automotive, or capital-goods industries. Proved successful administrative ability in organization operating under the concept of specific delegated responsibility or authority. $35,000–$45,000; pension plan, group insurance, and hospitalization in effect. East. Y-7827.

Materials-Handling Co-Ordinator, 35–45, engineering degree and experience covering production methods and control in wood products, building materials, or allied fields, warehousing and shipping, to survey and analyze existing methods, plan improvements, and establish standards in mills and warehouses for manufacturer. $8000–$9000. Headquarters, New York, N. Y. Y-7840.

Mechanical Engineer, 25–30, graduate, for design research, and development of complete facilities in power and process planning. Should have a firm grasp of the theory and some practical experience in thermodynamics and applied mechanics. Special staff position with long-established engineering and consulting organization. $6000–$7000. Eastern Pa. Y-7878.

Senior Field Engineer, over 35, mechanical, at least ten years' experience in installation of turbines, generators, boilers, and allied steam-power-plant equipment. Will take charge of mechanical phases of steam-power-plant construction and installation of equipment for an engineer. $7800 and up. Calif. T-9288.

Designer, 28–35, two years' or more experience designing tools, dies, molds, or special automatic machinery. Will work on the board designing tools, dies, and special machinery for filters, plastics, metal products, and other articles, for a manufacturer of varied products. $7200. Company will pay placement fee. Minn. T-9299.

Foundry Engineer, 33–45, three to five years' experience in designing foundries and/or operations. Good practical foundry background. Knowledge of steel-foundry operations. Will modernize and mechanize an existing foundry, for a steel foundry. Should be able to speak Portuguese or a Scandinavian language. $10,000–$12,000. Company will pay placement fee. South America. R-9300.

Designer, 30–45, mechanical degree or equivalent, five years' experience in the design of heavy duty off-the-road drive axles. Knowledge of axles, and axle-manufacturing procedures. Will design and develop afore-mentioned products following through the actual production for a manufacturer of tractors. $5500 and up. Company will pay placement fee. Ill. R-9309.

Project Engineer, mechanical, ten years' or more experience in design of machine tools. Knowledge of detailed machine-tool operations. Special tool design, processing, and welding. Will do project work modernizing entire line of pumps, compressors, and auxiliary equipment. Will be liaison between research engineering and manufacturing, to develop the best and most economical line produced by best methods for a manufacturer of pumps. $8000. Ill. R-9312.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Dec. 25, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Members, Associate, or Junior

APOSTOLIDIS, VENIZELOS A., Athens, Greece
ARNOLD, JAMES R., Atlanta, Ga.
BABBITT, WILBUR E., Marblehead, Mass.
BAUMGARTNER, WILLIAM H., Chicago, Ill.
BENNETT, JOHN L., Jr., Pittsburgh, Pa.
BERGELIN, OLAF P., Newark, Del.
BOWEN, CARL M., Chicago, Ill.
BRANDS, JOHN W., Richland, Wash. (Rt&T)
BRICKNER, SOLOMON S., Brooklyn, N. Y.
BROWER, BURTON, Netcong, N. J.
BRYANT, OZRO N., Prospect Park, Pa. (Rt&T)
BURKE, HAROLD J., Youngstown, Ohio
BURNET, ROBIN G., Blacksburg, Va.
BURRIS, JOHN G., Tulsa, Okla.
BURRIS, RICHARD F., San Antonio, Texas
CASTELLANOS, LEOPOLD J., Houston, Texas
CATUDAL, FRANCIS W., West Hartford, Conn.
CLARK, EUGENE S., Stratford, Conn.
CULL, THOMAS A., St. Albans, L. I., N. Y.
CUTRER, WILLIAM H., Baton Rouge, La.
DAOUSSIS, SPYROS M., Teaneck, N. J.
DAY, WILLIAM P., Cleveland, Ohio
DEWEY, LLOYD P., Youngstown, Ohio
DOWNEY, JAMES R., Wilmette, Ill.
DOYLE, HERBERT B., New York, N. Y.
EATON, HARRY B., Jr., Pennsgrove, N. J.
EAUPEL, JOSEPH H., Wilmington, Del.
ECOFF, RALPH A., Jr., St. Louis, Mo.
EILON, SHMUEL E., London, England
FANTONE, JOSEPH C., Jr., Buffalo, N. Y.
FARLEY, JOHN G., Jr., Birmingham, Ala.
FIELDING, JOHN R., Savannah, Ga.
FREEMAN, ANDREW R., Washington, D. C.
FULTON, ROBERT P., Ozone Park, N. Y.
GANBERT, FRED, Syracuse, N. Y.
GIBBONS, WILLIAM J., Waterbury, Conn. (Rt&T)
GOMES, FERDINAND D., Bombay, India
GRAHAM, CLIFTON B., Oak Ridge, Tenn.
GREGORY, WARREN P., Louisville, Ky.
GRIFFITH, ROBERT K., Wyncote, Pa.
HABERMANN, CARL E., New York, N. Y.
HALL, GORDON R., Schenectady, N. Y.
HALPERN, MARSHALL, Burbank, Calif.
HANNA, RICHARD E., Tulsa, Okla.
HARRISON, DEAN C., Park Forest, Ill.
HEATH, HARRY A., Toledo, Ohio
HEISER, ROBERT A., Pottstown, Pa.
HERTER, THOMAS L., Allentown, Pa.
HUBBS, GEORGE L., Charleston, W. Va.
JACOBSON, LEON, Toledo, Ohio
JENKINS, RAYMOND E., Lafayette, La.
JESSE, EDWIN L., Berwick, Pa.
JOHNSON, IVAR, Philadelphia, Pa.
JOYCE, HARDIN, Jr., Erie, Pa.
KENNEY, JOHN A., Dunkirk, N. Y.
LAMBERTA, WILLIAM S., Ridgewood, N. Y.
LIPP, GEORGE D., Corning, N. Y.
LOUGHLIN, JOHN J., Chicago, Ill.
LUNDAHL, LLOYD E., Jr., San Francisco, Calif.
MADDOCKS, FRANK E., Jr., Natick, Mass.
MAHAFFAY, WILLIAM E., Benton Harbor, Mich.
MALLIN, RALPH J., New York, N. Y.
MARTIN, LEE, Edwardsburg, Mich.
MATTHEWS, SAMUEL J., 3RD, New Orleans, La.
MATTHIESEN, ALBERT H., Washington, D. C.
MCDOUGALL, JOHN, Huntington Woods, Mich.
MCGARRAUGH, MAURY M., Los Angeles, Calif.
MCKEE, PAUL W., Williston, S. C.
MCMASTER, CLARENCE O., St. Paul, Minn.
METZ, ERWIN H., Chicago, Ill.
MIKRIPASSI, TAGHI J., New York, N. Y.
MORGAN, JOSEPH P., Old Lyme, Conn.
NEALE, WILLIAM M., Jr., Raleigh, N. C.
NELSON, PERCY L., Waban, Mass.
NUSBAUMER, JOSEPH A., Jr., Seaford, Del.
OPENSHAW, ARTHUR B., Jr., Chicago, Ill.
PENG, KINGSTON F., Chicago, Ill.
PIERSON, PERRY D., York, Pa.
PLANTE, ROBERT P., Ottawa, Ont., Can.
PLEVNIAK, GEORGE A., Youngstown, Ohio
QUINN, JOHN A., Chicago, Ill.
RASMUSSEN, EINAR L., Hollis, N. Y.
REEVE, JOHN R., Jr., Tulsa, Okla.
REEVES, JAMES M., Massapequa, N. Y.
RENNIE, JAMES W., North Plainfield, N. Y.
ROBERTS, GEORGE R., Longfield, Kent, England
ROSEMAN, WALTER W., Pittsburgh, Pa.
ROSENWALD, ROBERT V., Robbinsdale, Minn.
ROTH, HERBERT H., Lima, Ohio
SAUPE, WILLIAM E., Schenectady, N. Y.
SHANECK, ROBERT W., Toledo, Ohio
SIMPSON, JOHN W., Library, Pa.
SLEPOW, LEON D., Miami, Fla.
SMITH, HARRY T., Marietta, Ohio
SONDHOFF, PAUL A., Forest Hills, L. I., N. Y.
STAAK, LOUIS E., Fort Wayne, Ind.
STARK, RAYMOND P., Warren, Ohio
STEVENSON, JOHN W., Regina, Sask., Can.
TEMPLER, JOHN A., Marblehead, Mass.
THORNBURGH, JAY W., Toledo, Ohio
THORNLEY, ROBERT F., Buffalo, N. Y. (Rt&T)
TOESCA, RENE A. M., Schenectady, N. Y.
TOMLINS, STUART G. W., London, England
TOTH, JULIUS A., South Bend, Ind.
VERMA, VISHENDAS B., Amritsar, India
WADLEIGH, KENNETH R., Cambridge, Mass.
WALLS, ROY E., New York, N. Y.
WALTERS, JOHN G., Weybridge, England
WHITE, NEAL W., Wakefield, Mass.
WILLIAMSON, MYLES, Ridgewood, N. J.
WILSON, RAYMOND R., Lakewood, Ohio
WOLTER, GILBERT R., Bloomington, Ill.

CHANGE IN GRADING

Transfers to Member and Associate

CHEW, BERNARD B., Inglewood, Calif.
CORR, JOHN E., Scotia, N. Y.
FEIGE, WILLIAM F., Huntington Woods, Mich.
FOX, EARLE B., Binghamton, N. Y.
GILBERT, ARTHUR C., Jamaica, L. I., N. Y.
HAWKINS, EDWARD C., Baltimore, Md.
JACOBSON, HARVEY, Kenilworth, N. J.
LANCASTER, JOHN E., Harrison, N. J.
LANG, HANS J., Monrovia, Calif.
MOORE, ALBERT H., Jr., Greensburg, Pa.
RAISLER, HERBERT A., Scarsdale, N. Y.
SCHNEIDER, FRED, Forest Hills, L. I., N. Y.
SEFING, NICHOLAS R., New Philadelphia, Ohio
SIHLER, JOHN H., Washington, D. C.
STEPHENSON, KEVIN Y., Elmhurst, L. I., N. Y.
WEBB, BAXTER H., Detroit, Mich.

Transfer from Student Member to Junior 60

Obituaries

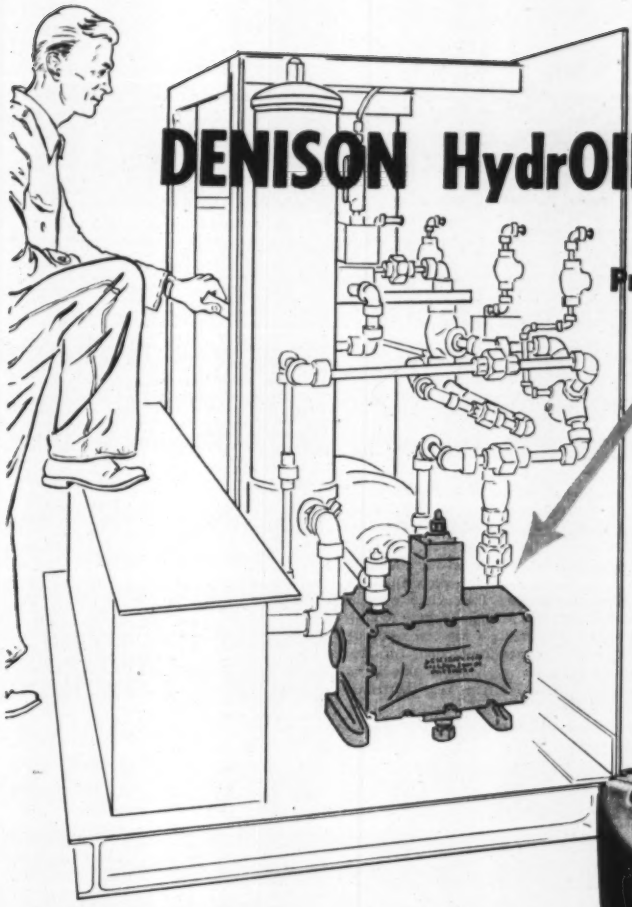
Benjamin H. Bowlus (1889–1952)

BENJAMIN H. BOWLUS, general manager, Plastic Mold Division, C. L. Gougher Machine Co., Kent, Ohio, died Sept. 12, 1952. Born, Williamsport, Ind., March 12, 1889. Parents, Abraham L. and Mary Emma (Jones) Bowlus. Educa-

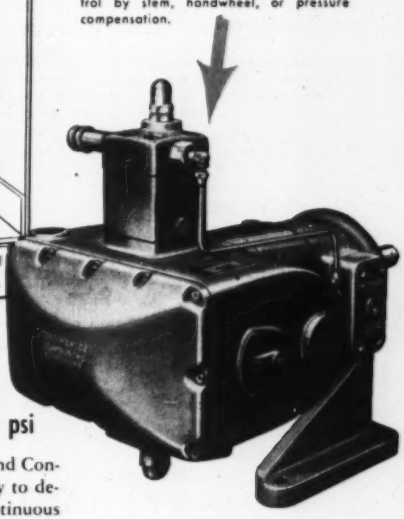
(*ASME News continued on page 1054*)

DENISON HydrOILic PUMPS

Prove their EXTRA STAMINA in tough jobs like this



The exclusive design of Denison's axial-piston, constant-displacement HydrOILic Pumps provides exceptionally high volume delivery at all operating pressures—and with oils of widely varying viscosities. They're ruggedly built for long, low-maintenance service. Available in constant and variable volume types—volume control by stem, handwheel, or pressure compensation.



Million-Cycle Test Operations Call for Hydraulic Components That Withstand Hard, Continuous Duty at Pressures of 5000 psi

Three million test loads of 35,000 pounds each — applied at the rate of one every second! That's the job assigned to this high-pressure hydraulic system designed and built in the Fritz Engineering Laboratory, at Lehigh University, for a research project on prestressed concrete beams.

It's a tough job for any hydraulic system — *but it's the kind of job Denison High Pressure HydrOILic Equipment is built to handle.* In addition to the HydrOILic Pump shown above, this test circuit includes a Denison 4-Way Directional Control Valve, a Relief Valve, a Sequence Valve, and a Surge Damping Valve — all designed for 5000 psi duty.

For more than a quarter of a century Denison HydrOILic Pumps and Controls have *proved* their ability to deliver an extra measure of continuous heavy-duty service, under almost any condition. Their rugged, compact design simplifies circuit design and reduces costs.

HydrOILic Pumps offer volume capacities ranging from 2 to 35 gpm . . . HydrOILic Fluid Motors provide torque ratings up to 5585 inch-pounds, or approximately 160 hp. . . HydrOILic Pressure Controls include relief, sequence and unloading types in sizes up to two-inch . . . HydrOILic Surge Damping Valves, made in both industrial and aircraft types, eliminate pressure shock in hydraulic circuits . . . HydrOILic 4-Way Valves are available with seven different types of controls . . . Pilot-Operated HydrOILic Valves meet high-pressure long-cycling needs.

Write for further information on the complete line of Denison HydrOILic Equipment.

The DENISON Engineering Co.
1189 Dublin Road, Columbus 16, Ohio

DENISON HydrOILics

tion, high-school graduate; self-directed study of engineering. Married Doris Harding Smith, 1923. Mem. ASME, 1941. Survived by wife and four sons, Sanford S., Erie, Pa.; John M., Washington, D. C.; David B., Erie; Willard H., Royal Oak, Mich.

Abraham Bowman Clemens (1867–1951)

A. B. CLEMENS, dean emeritus, school of technology, International Correspondence Schools, died May 26, 1951. Born, Kitchener, Ont., Can., Oct. 20, 1867. Parents, George H. and Salome Clemens. Education, attended McGill University; ME, Cornell University, 1892. Naturalized U. S. citizen, Scranton, Pa., 1902. Married Florence B. Weaver, 1896 (deceased); son, Norman W. Married 2nd, Anna E. Andrew, 1909 (deceased). Author of several ICS texts on mechanical-engineering subjects. Mem. ASME, 1904. Served the Society as manager, Anthracite-Lehigh Valley Section.

Jan Rubidge Dunsford (1883–1952)

JAN R. DUNSFORD, mechanical engineer and director of Dunsford Co., Pittsburgh, Pa., died in January, 1952. Born, Caledonia, Ont., Can., Aug. 20, 1883. Parents, John L. and Emmaline (Mortimer) Dunsford. Naturalized U.S. citizen. Education, ME, Ohio State University, 1908. Married Marguerite E. Herbst, 1911; children, Jan R., Jr., Elizabeth H. Mem. ASME, 1931.

Francis Phinizy Gary (1889–1952)

FRANCIS P. GARY, partner and sales engineer, Lawrence V. Fraley & Son, St. Louis, Mo., died March 16, 1952. Born, Augusta, Ga., March 13, 1889. Parents, William T. and Fannie H. (Phinizy) Gary. Education, BSME, Georgia Institute of Technology, 1909; ME, Cornell University, 1910. Married Nadine Spoonts, 1923. Held U. S. Patents on improvements in traveling water screens. Assoc-Mem. ASME, 1921; Mem. ASME, 1935. Survived by wife.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

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Transactions. ☐ Journal of Applied Mechanics. ☐ Applied Mechanics Reviews. ☐

Frank Wolfert Kouwenhoven (1893–1952)

FRANK W. KOUWENHOVEN, associate professor in mechanical engineering, The Johns Hopkins University and consulting engineer, died Aug. 20, 1952. Born, Brooklyn, N. Y., Jan. 13, 1893. Parents, Tunis G. B. and Phebe F. (Bennett) Kouwenhoven. Education, ME, Polytechnic Institute of Brooklyn, 1916. Married Alice H. Witherell, 1921; children, Phyllis, Gertrude B., Alice W. Coauthor of "Mechanics for Engineers." Jun. ASME, 1917; Assoc-Mem. ASME, 1925; Mem. ASME, 1935.

Armen Stapan Kurkjian (1883–1952)

ARMEN S. KURKJIAN, member, board of directors, Oliver Machinery Co., Grand Rapids, Mich., died Aug. 10, 1952. Born, Palu, Armenia, Turkey in Asia, Feb. 17, 1883. Parents, Stephen and Anna Kurkjian. He was a U. S. citizen. Education, BS(ME), University of Michigan, 1908. Married Augusta Wurzburg, 1916. He was extremely active in local civic and philanthropic organizations. Assoc-Mem. ASME, 1922; Mem. ASME, 1935. Survived by wife and two sisters, Mrs. L. S. Goolian, Mrs. M. A. Baloyan.

Oscar Adolf Hadar Ortman (1898–1952)

HADAR ORTMAN, executive vice-president, McClure, Hadden & Ortman, Inc., management engineers, Chicago, Ill., died Sept. 5, 1952. Born, Nordmaling, Sweden, June 20, 1898. Parents, Oscar A. and Elisabeth (Arctaedius) Ortman. Education, graduate, Royal Institute of Commerce, Stockholm, Sweden, 1918; postgraduate studies in business and engineering, Dartmouth College, 1922–1923; Columbia University (evening), 1923–1925. Married Marguerite R. R. Gonda, 1926. Assoc-Mem. ASME, 1930; Mem. ASME, 1935.

Schuyler Colfax Page (1886–1952)

SCHUYLER C. PAGE, retired supervisor, service department, Creamory Package Manufacturing Co., Buffalo, N. Y., died Aug. 29, 1952. Born, Red Wood Falls, Minn., May 5, 1886. Parents, Schuyler C., Sr., and Harriet F. (Winkley) Page. Education, public schools; combustion engineering, Hays School. Married Irene Gurtrude Cawley, 1911 (died 1924). Married 2nd, Jane Gold, 1926. Assoc-Mem. ASME, 1930; Mem. ASME, 1935. Survived by wife and five children by his first marriage, Mrs. Ralph Ingold, Rochester, N. Y.; Mrs. Henry Weir, Poughkeepsie, N. Y.; Stanley J., Helmuth, N. Y.; Jerome C., Philadelphia, Pa.; Mrs. George Kath, Minneapolis, Minn.

Albert Barnett Paterson (1883–1952)

A. B. PATERSON, chairman of the board, New Orleans Public Service, Inc., New Orleans, La., died Aug. 6, 1952. Born, Blantyre, Ont., Can., Jan. 20, 1883. Parents, Albert C. and Zillah (Shepardson) Paterson. Education, attended College of Commerce, Toronto. Married Annie Evans Brown, 1908; children, Ann (Mrs. John A. Mills), Albert B., Margaret (Mrs. Eugene H. Countiss). Mem. ASME, 1920.

Frederic Emery Pierce (1870–1952)

FREDERIC E. PIERCE, retired engineer, died at his home in Ridgefield, Conn., Sept. 8, 1952. Born, Flemington, N. J., Sept. 24, 1870. Education, CE, Columbia University school of mines, 1892. Married Ethel Denton Smith. Mem. ASME, 1909. Survived by wife.

Ben Jacob Schmid (1911–1952)

B. J. SCHMID, assistant engineer, steam power plant design department, Pacific Gas & Electric Corp., San Francisco, Calif., died Sept. 21, 1952. Born, Monroe, Wis., Feb. 2, 1911. Parents, Adolf and Rose Schmid. Education, BSME, University of Wisconsin, 1933. Married Geraldine B. Schindler, 1935. Jun. ASME, 1939.

Stanwood Willston Sparrow (1888–1952)

STANWOOD W. SPARROW, vice-president in charge of engineering, Studebaker Corp., South Bend, Ind., was injured fatally in an automobile accident. He died in Harrington Memorial Hospital, Southbridge, Mass., Aug. 14, 1952. Born, Middleboro, Mass., Nov. 18, 1888. Parents, Samuel J. and Emma J. (Ward) Sparrow. Education, BS(ME), Worcester Polytechnic Institute, 1911; hon. DE, 1949. Jun. ASME, 1918; Assoc-Mem. ASME, 1919; Mem. ASME, 1923. He was president, SAE, 1949.

Raymond Christian Striker (1889–1950)

RAYMOND C. STRIKER, supervisor, mechanical department, H. E. Beyster Corp., Detroit, Mich., died Nov. 19, 1950, according to a notice recently received. Born, Fort Wayne, Ind., Sept. 16, 1889. Education, Fort Wayne Electrical Works Trades School, 1906–1907; ICS, 1907–1912; Fort Wayne Engineering School, 1909–1910. Mem. ASME, 1949.

exclusively spiral-wound construction

Forty years ago, when Henry Bohmer originated Flexitallic Spiral-wound Construction in gaskets, flange standards were 250 lbs., 400° saturated steam. Today flange standards are 2500 lbs. and 1050° superheat. The Flexitallic Gasket has played an important role in this development. As pressures and temperatures rose Flexitallic engineers found the combination of metal "spring" and non-metal filler that would hold the seal. Now, in the Process Industries, with pressures and temperatures rising to heights undreamed of even a few years ago—pressures to 4000 lbs., temperatures to 2000° F.—and with new acids and new gases coming into being almost every day, Flexitallic engineers are thinking ahead with the leaders in Industry in the adaptation of the Flexitallic Spiral-wound Construction to problems of the future. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

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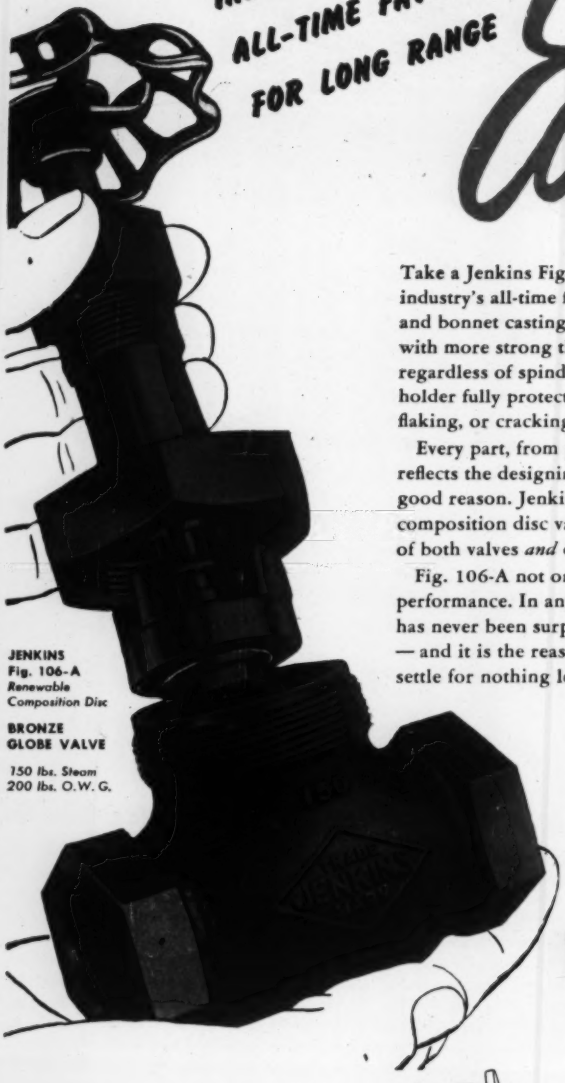
INDUSTRY'S ALL-TIME FAVORITE FOR LONG RANGE *Economy*



JENKINS
Fig. 106-A
Renewable Composition Disc
BRONZE GLOBE VALVE
150 lbs. Steam
200 lbs. O.W.G.

Take a Jenkins Fig. 106-A apart. It's easy to see why it is industry's all-time favorite. Note the liberal dimensions of body and bonnet casting — the heavy, manganese bronze spindle, with more strong threads in contact with the bonnet, regardless of spindle position. See how the slip-on, stay-on disc holder fully protects the edge of the disc, prevents creeping, flaking, or cracking.

Every part, from perfect grip, heatproof handwheel to pipe ends, reflects the designing skill of Jenkins valve *specialists.* There's a good reason. Jenkins Bros. introduced the *first* renewable composition disc valve, — is today the only manufacturer of both valves *and* discs.

Fig. 106-A not only looks better — it proves out better in performance. In any comparison, its long life, low upkeep record has never been surpassed. That is the true measure of valve cost — and it is the reason why industry's shrewdest buyers will settle for nothing less than Fig. 106-A quality.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864
TRADE JENKINS MARK
Jenkins Bros.

GET THIS FOLDER — Gives details of Fig. 106-A design, and "family" interchangeability. Ask your Jenkins Distributor for Form 189-A, or write Jenkins Bros., 100 Park Ave., New York 17.

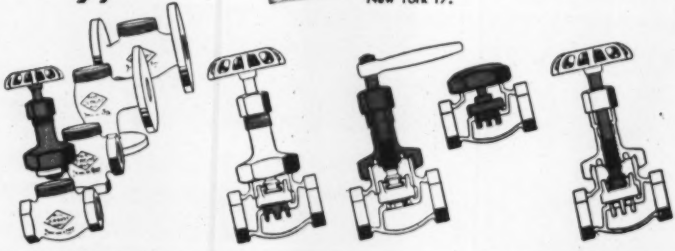


Fig. 106-A "Family" Interchangeability meets 90% of your valve needs with a small inventory of parts. Start with the standard Fig. 106-A. Trimming is interchangeable in Globe or Angle body, screwed or flanged. With a few parts, quickly-assembled combinations provide a Lift Check, a Spring-loaded Check, and valves for Stop and Check, Quick-opening, or Throttling service.

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ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

New Equipment *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

New Equipment

Electric Ovens

Thousands of automobile accessories and trim parts are washed, dried, and given three coats of baked-on finish in four new prefabricated electric ovens at the Detroit plant of the Metal Mouldings Corp.

The ovens, designed and built by Jensen Specialties, Inc., occupy only 624 sq ft of floor space, about 25% of the requirement for convection type ovens. With a 700-ft monorail conveyer and electrostatic spray painting, the system is entirely automatic except for loading and unloading. Space required is only 63 × 72 ft, with 13 ft of headroom.

Radiant heating for these Jensen ovens is produced by General Electric Calrod tubular, plug-in, lock-in type heaters. The heaters have a life in excess of 8000 hr. They are mounted in wall panels through a

rapid temperature elevation zone. These panels open outwardly to permit servicing of all electrical parts from outside the oven. Finned Calrod heaters provide instrument-controlled convection for the temperature holding zones.

A master electrical control panel provides sequence starting. It will automatically shut the system down in the event of a fault condition. This avoids stripping and refinishing of production parts.

The heaters and their lock-in type receptacles permit all electrical connections to be made outside of the heating zone. Cold sections in the heaters prevent heat loss through the insulated wall and at the supporting points. Special aluminum reflectors control the radiant energy delivered by the heaters, and otherwise reduce thermal losses through the walls.

Automatic Lowerator

An automatic lowerator-conveyer system, the first of which has been installed at the Continental Can Co., Baltimore, Md., is announced by the Gifford-Wood Co., Hudson, N. Y. Particularly applicable where fairly large quantities of materials must be transported between floors with relative frequency, the new automatic system releases elevators and fork trucks for other work, relieves plant traffic conditions, and cuts work-hours.

The system comprises three major units: (1) the lowerator, (2) a feeder conveyer, and (3) a take-off conveyer. All three units are automatically interlocked and controlled by electric eyes and limit switches so that when the feeder conveyer receives a load it automatically delivers it to the lowerator which automatically descends and delivers the load to the take-off conveyer from which it is removed for storage, etc. One element of the system will not discharge its load until the next is ready to receive it.

The lowerator and conveyers are constructed to fit given space requirements and to handle specific loads. They can operate in either or both directions.

Weather-Protected Motor

A new outdoor-weather-protected motor which carries protection much further than the splashproof design has been announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis., for use in semi-outdoor and outdoor steam electric stations.

The new motor is designed to keep wind-driven heavy moisture out of its windings. Its intake velocity has been reduced to less than 600 fpm, so heavy rain particles cannot be drawn into the motor. Air moves vertically upward through side intakes into a greatly expanded air space, further lowering its velocity.

Rain gutters are provided on the sides at the air intakes, draining through pipes to the ground. During periods of extremely heavy rain, the water running down the sides of the motor will be drained away before water droplets can be accumulated in any great quantity at air intake openings. The top of the yoke is slanted slightly to keep water from accumulating in puddles on top.

To prevent dust and dirt from entering the machine during periods of dry weather, the air intakes are located at a considerable height above ground level.

The weather-protected motor is available in the full range or ratings required for major auxiliary drives, including boiler feed pumps.

Welding

Krembs & Co. have perfected a shielded copper welding electrode and welding procedure for metallic arc welding copper and all copper alloys as well as cast iron and steel.

The metallic arc welding method has long been employed in making welds on steel. After several years of intensive research and experimental work, the company laboratory has perfected "Kop-R-Arc" electrodes and special welding procedure and metallic arc welding which can now be successfully employed in making welds on Copper. It also has been found the "Kop-R-Arc" makes strong and ductile welds on all copper alloys, also steel, cast iron, and standard-steel. A bulletin describing this new process is available from Dept. M, Krembs & Co., 669 W. Ohio St., Chicago 10, Ill.

Building Survey

By building upwards within existing plants, American industry hopes to meet critical space needs quickly and economically, a survey of 100 manufacturing concerns in the East and Mid-West indicated. The survey was conducted by field engineers of the Irving Subway Grating Co., Long Island City, N.Y., in plants of all sizes, ranging in age from ten to 100 years.

Seventy of the 100 reported overcrowded facilities, but only 50 said they were considering expanding. Of the 50, 23 said they could cope with the space problem by vertical expansion, via balconies and mezzanines suspended from ceilings or built up from floors. The other 27 reported they were planning new buildings. In this latter group, many had inadequate overhead clearance for vertical installations while some in heavy industry had complicated overhead crane and rail networks.

The survey covered such manufacturing activities as machinery parts and assembly, aircraft, automotive, industrial chemical, metal fabricating, textile mills, warehousing, foundry, heating and air conditioning, glass containers and sand blasting equipment, among others.

Courtesy Lear, Inc.

in instruments where reliability is imperative

SILASTIC* works

where other materials fail

To assure maximum service life and accuracy, engineers at Lear, Incorporated, planned to protect their new vertical gyro-mechanism from corrosion by housing it in a completely inert and dehydrated atmosphere.

Sealing the housing, however, proved to be more easily said than done. Despite the most elaborate precautions, solder and flux fumes often penetrated the joint and contaminated the delicate mechanism. Once sealed, it was impossible to reopen the case without loss of the expensive cover and harness.

To both of these problems a simple and ingenious solution was found. A thin O-ring of Silastic molded to fit snugly under the cover flange is used to exclude the corrosive fumes generated in soldering a metal strip over the entire joint. The Dow Corning silicone rubber O-ring is not damaged by soldering temperatures. And, the gyro-mechanism is just as accessible for repairs as the contents of a hermetically sealed can of coffee.

Lear also uses a large ring washer of Silastic at each end of the housing to serve as resilient, shock-absorbing cushions for the apparatus at stratospheric temperatures.

And that's just one of hundreds of examples of how Silastic is used to improve the performance of products ranging from cable to traction motors, from domestic steam irons to aircraft.

*T. M. Reg. U. S. Pat. Off.

For more information about the properties or fabricators of Silastic, mail this coupon today or phone our nearest branch office.

Dow Corning Corporation, Dept. Q-24, Midland, Mich.

Please send me:

- ☐ Silastic Facts 10a with new data on properties and applications of all Silastic stocks and pastes.
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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

In key centers where industrial sites are at a premium, plant-management conceded their most practical means of acquiring additional space hinged upon more efficient use of cubic footage, rather than square footage.

Structural steel grating for balconies and mezzanines was seen by most of those planning to expand vertically as having several important advantages. They cited its adaptability to quick and inexpensive installation, its easy removal when no longer needed, its ventilating and fireproof properties, its ability to survive rough usage with little or no maintenance and its lightness requiring only minimal structural support.

Many uses for balconies and mezzanines are projected by industry. Among the purposes listed were removing motors and other machinery from the working floor to get additional space for manufacturing; doubling and tripling storage space for small parts; suspending bulky air conditioning equipment; maintenance platforms for complicated machinery; storaging old filing cabinets where they are easily accessible; additional office space, and additional space for automatically operated machinery.

Several large firms with the property to expand horizontally prefer vertical construction now to meet immediate space needs in a hurry. In smaller plants, limited resources, plus the need for a quick remedy to the space headache, stimulate interest in better utilization of existing facilities.

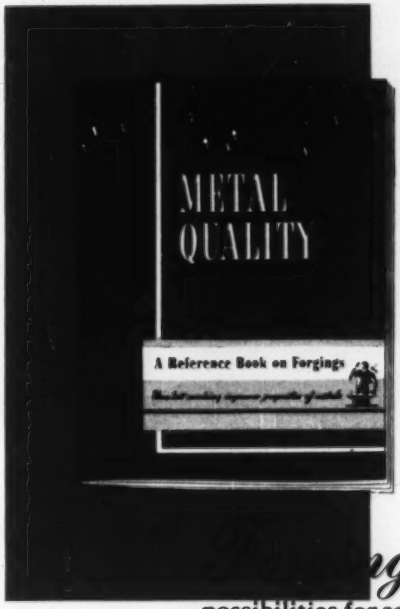
Symons V Screen

The "Symons" V screen, a new high-capacity unit for sharp separation of wet or dry materials from 4 mesh to the very fine meshes is announced by Nordberg Mfg. Co., Milwaukee, Wis., following thorough testing in the field.

Combining a centrifugal action the equivalent of five times the force of gravity with a gyratory movement, the new screen has the ability, depending upon the type of material being screened to considerably increase existing capacities and also provide utilization of product heretofore difficult to screen. Since the screen is used in circuit with other equipment however, its capacity depends on factors other than the screen itself.

With a minimum of height and width, the Symons V screen requires little floor space and it is easily installed. Its vertical design makes it particularly advantageous for use under vertical chutes. The unit is completely enclosed assuring dustless operation and easily removable covers permit ready access to the screen. The actuating mechanism is mounted on roller bearings and the vertical frame is constructed of standard steel shapes and plates.

This cylindrical screen, mounted vertically, is presently manufactured in one size, 3 ft high and 12 ft in circumference resulting in 36 sq ft of screening surface. A cupped feed plate with radial vanes sets a little below the upper edge of the drum. Material to be screened enters through an opening in the top of the frame and is impinged by the feed plate against the inner surface of the drum. The oversize particles are held against the screen for a brief interval with the fines passing through. Using 14 gyrations to one drum rotation, each gyration of the drum produces an inward deflection of the material being screened. This frees the holes in the screening surface for the passage of undersize at the next contact and permits the material to drop a short distance. This process is repeated in a



Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on Forgings. Write for a copy.

...ngs offer unlimited possibilities for solving Problem Parts Problems without creating other problems for other people. Check all the aspects of a problem part with the unrivaled economic and mechanical advantages of closed die forgings, and the closed die forging process for producing parts, and you will discover the possibilities for solving a problem part with closed die forgings. Then, consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.

DROP FORGING ASSOCIATION
605 HANNA BLDG • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal", 1949 Edition.

Name _____
Position _____
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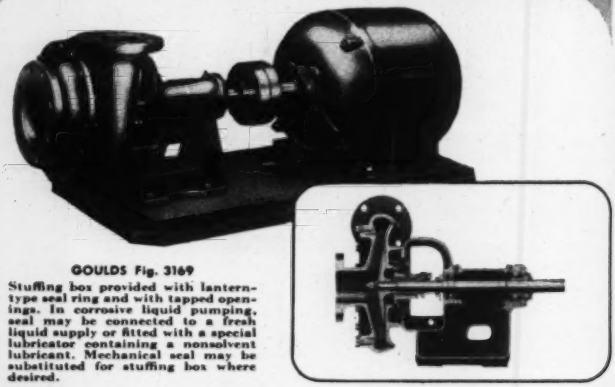
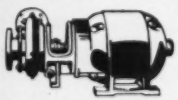
Goulds single stage... open impeller centrifugal



GOULDS Fig. 3169

Stuffing box provided with lantern-type seal ring and with tapped openings. In corrosive liquid pumping, seal may be connected to a fresh liquid supply or fitted with a special lubricator containing a nonsolvent lubricant. Mechanical seal may be substituted for stuffing box where desired.

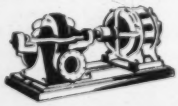
Other GOULDS Pumps for the Chemical Industry



GOULDS Fig. 3650

"Close-Cupld" single-stage centrifugals for general industrial use. Capacities to 2000 G.P.M. Heads to 400 ft.

GOULDS Fig. 3730—"Support Head" Goulds centrifugals for general and many special liquid handling applications. Up to 4000 G.P.M. Heads up to 400 ft. Bulletin 715.1.



GOULDS Fig. 3450

These double-suction, single-stage Goulds centrifugals will handle up to 15,000 G.P.M. Heads up to 500 ft. Send for Bulletin 721.2.

One pump that does many different jobs

- General Water Service
- Transfer
- Processing
- Slurries
- Circulation
- Factory Wastes
- And Many Others

This low cost Goulds Fig. 3169 centrifugal pump offers tremendous versatility. It is as much at home in industrial processing as it is in handling general water service or plant wastes. Its simple, sturdy construction assures long service life with a minimum of maintenance.

Compactly built, this pump is a real space saver. Its modern hydraulic design assures high operating efficiency with relatively low power consumption. Available in a wide range of sizes for both motor and belt drives. Capacities to 1080 G.P.M. Heads to 290 ft. For complete details and specifications, write for Bulletin 720.4.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

similar manner until the particle either goes through the cloth or is discharged as oversize.

When used for wet screening, water sprays are mounted in the lower assembly with sprays impinging upward and outward.

The screen is built with various types of discharge bases either wet or dry depending upon installation requirements.

In dry screening the natural fanning action carries the "air float" fines through with the undersize. This fanning action makes the Symons V screen very effective in screening lightweight materials. It has been used successfully in the field for screening pumice, sand, plaster sand, coal dust, copper ore, potash, volcanic cinders, crushed mica, ground phosphate rock, and crushed rock.

Liquid-Level Control

A new electrical system for sewage and water level control and indication has been announced by the General Electric Company's Control Dept.

Called Thermasul, the new system can be used in wet wells, pumps, reservoirs, elevated tanks, standpipes, etc., and will control pump motors, pump motor speeds, and supervisory and alarm circuits.

Basically, the Thermasul element consists of a temperature-sensitive, sintered-sulphide compound around which is wound a resistance heater; the whole assembly hermetically sealed in a stainless-steel tube. In air, resistance of the element is low because the heater keeps the level detector approximately 280 C above the ambient air temperature. When the detector is immersed in liquid, however, the heat is conducted away and the resistance of the element jumps up rapidly, operating a small, remotely located relay.

Thus, the Thermasul element acts as a switch, opening and closing the relay with the presence or absence of liquid. The relay, in turn, can be used to control pump motors, and circuits for alarm, supervisory, and control equipment. With the addition of standard accessories, Thermasul permits great versatility in pump programming.

According to G-E engineers, the noncorrodible construction and self-cleaning characteristics of the new device make it exceptionally useful for unattended locations. Deposits do not normally adhere to the detecting element because of the high operating temperature.

Thermasul systems can be mounted with simple pipe supports. Three conductor cable connections from level detectors to auxiliary control are the only electrical connections required with the exception of power-line pick-up. There are no moving parts to jam or bind, no electrodes to be shorted or otherwise fouled by deposits, and Thermasul is not adversely affected by greasy films or ice, the engineers said.

Both straight and hooked probes are available, the latter for use in low-level detection. Detectors are offered in lengths ranging from 1 to 10 ft, and an additional 10-ft length of neoprene-covered cable is included.

Additional information on G-E Thermasul liquid-level control is contained in bulletin, GEA-5766 which is available from the General Electric Co., Schenectady 5, N. Y.

For Consulting Engineers Turn to Page 142

Keep Informed

NEW EQUIPMENT
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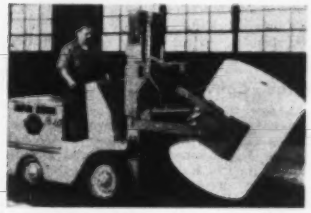
Detachable Roll Clamp

A quickly detachable roll clamp attachment for fork trucks, designed to pick up and stack cylindrical objects either horizontally or vertically has been developed by The Baker-Raulang Co., 1230 West 80th St., Cleveland 2, Ohio.

The new clamp allows truck operators to pick up and haul paper rolls, drums, large pipe, or any other cylindrical material from $1^1/_2$ to 3 ft in diameter. It rotates 90 deg in a vertical plane so loads may be stacked either vertically or horizontally. Clamping pressure is controlled by an adjustable relief valve in the hydraulic system, permitting operators to control clamping pressure for each type of material handled.



Installed on Baker's 4-purpose carriage—a special fork-truck carriage which combines the features of fork-spacing, side-shifting, clamping, and standard fork use—the clamp detaches in two minutes.

This quick-change ability makes it possible to switch from roll handling to pallet handling as often as necessary without interrupting work schedules.

Two men can detach the clamp by removing retaining pins at the base of the truck carriage, detaching two push-pull Hansen couplings on the clamp's hydraulic line and lifting the clamp off the carriage. Next, a set of forks is installed and locked by the retaining pins—and the truck is ready for pallet loads.

With the clamp removed, the truck operator is able to use the side-shifter to get in close to columns and warehouse walls with his pallet loads.

The new attachment is available for any Baker fork truck from 1000 to 4000 lb capacity.

Coal Unloader

Tennessee Coal & Iron Div. of United States Steel Co. will handle imported ore at its new iron ore terminal in Mobile, Alabama, with a 15-ton capacity unloader being constructed by Dravo Corp., Pittsburgh, Pa.

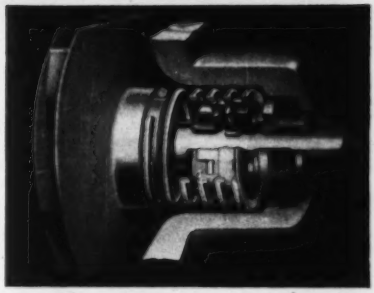
The unloader, operating on four 8-wheel trucks along the dock of a slip in the Mobile River, will deposit ore from the holds of ships into hoppers feeding a 42-in-wide conveyer belt. The conveyer system is so arranged that ore may be loaded into railroad cars, barges, or delivered to storage. Design of the unloader permits the addition of a second conveyer belt. The unloader will feed to either or both belts. Additional unloaders may be added, and thus the terminal may be expanded as to both utility and capacity.

The unloader is similar to two others Dravo is building for U. S. Steel Company's new Fairless Works, in eastern Pennsylvania.

There's a JOHN CRANE Mechanical Seal To Meet Your Exacting Requirements

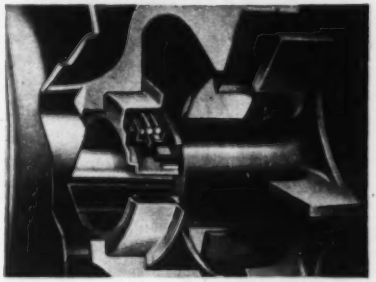
General Purpose Seal...

...most widely used end-face seal in industry... ideal for centrifugal, rotary and jet pumps, gear reducers and many other rotary shaft applications... offers long life, complete flexibility, easy installation. Two types available, No. 1 and 2, for varying equipment space conditions.



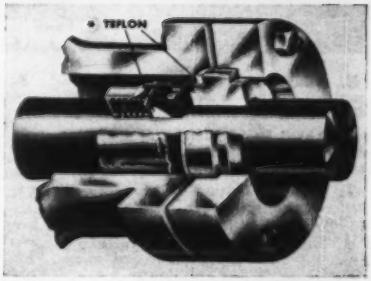
Low Cost, High Quality "Pressed-in" Seal...

...the answer to small shaft sealing applications involving high speeds and vibration. Millions of these Type 6A Seals are mass-produced for automotive water pumps, making them available at a relatively low cost in stock sizes. Each of these easy-to-install seals will fit all shaft sizes from $1^3/_{16}$ in. down to as small as $^1/_4$ in. and under.



High Temperature Anti-Corrosive Seal...

...This Type 9 Seal performs effectively at temperatures up to 485° F. It incorporates a *Teflon* flexible member which is unaffected by all known corrosive agents.



★ ★ ★

All seals in the "John Crane" line are end-face in design ...nothing touches the shaft which can score it. No matter what your mechanical sealing problem is, there's a "John Crane" seal designed to exactly "fill the bill". Our trained field engineers are ready to work with you in selecting the best seal for your needs.

Write for entirely new catalog on "John Crane" Mechanical Seals. It's just off the press!

*DuPont Trade-Mark for tetrafluoroethylene Resin

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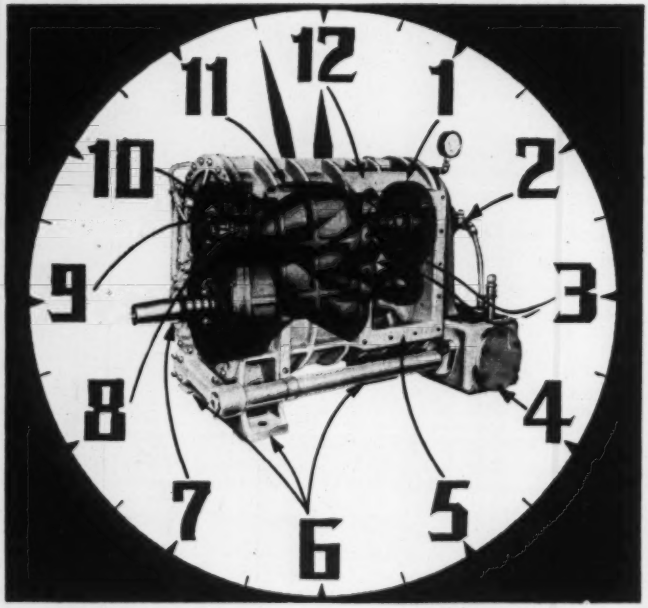
2. Pressure Lubrication System provides positive lubrication to all bearings and gears.

3. Axial Air Flow . . . the smooth, gradual delivery of air **minimizes shock** and sound pulsations . . . **it's different** in theory and performance.

4. Oil Reservoir at the suction end of the blower helps to reduce oil temperature . . . holds adequate supply of oil.



5. Adapter Plates are furnished with one of a multiple of standard drillings for different pipe sizes.

6. Three-Point Mounting eliminates distortion of housing . . . facilitates application.

7. Tapered Drive Shaft for accurate and positive connection of coupling or pulley.

8. Non-Wearing, Non-Leaking, balanced pressure labyrinth seals assure clean air at all times.

9. Anti-Friction Bearings with special thrust provisions assure long life under desired load and speed requirements.

10. Self-Centering Bearing Carriers prevent housing warpage and fix the clearance between rotors and housing.

11. Rigid Shape Screw Type Rotors pull the air in gently and squeeze it out evenly and quietly . . . designed for maximum pressures.

12. One-Piece Housing for strength, accuracy and stability of dimensions.

These Standardaire Blower features, time-tested in varied applications, assure superior performance and dependable operation. For further data write

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BLOWER-STOKER DIVISION

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Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

The ore bucket and operator's cab are suspended from a trolley that runs on the structural steel runway extending 109 ft over the water from the tower. The runway also projects 51 ft from the rear of the tower so that the area below can be used for temporary ore storage.

The boom over the water is hinged where it joins the tower so it can be raised almost vertically to clear superstructures of ships.

Individual adjustable voltage generators are used for each of the electric motors that operate the bucket. Another supplies the trolley travel motors, and a constant potential generator supplies the tower travel, apron hoist, and rail clamps.

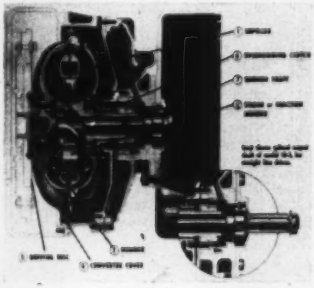
Dravo rail clamps are installed on the tower to prevent runaway in high winds. The clamps are operated electrically by a control in the cab, or will lock automatically if an anemometer mounted on top of the tower indicates excessive wind velocity.

Torque Converter Coupling

A new torque converter coupling drive designed to handle engines developing from 180 to 225 ft-lb of torque in the 2000–2200 rpm or higher range, is announced by the Fuller Mfg. Co., Kalamazoo, Mich.

The new drive offers the advantage of an automatic change from 2:1 torque multiplication to 1:1 coupling operation as torque requirement dictates.

Two types of output shafts are available. In model 12-S, a $1^1/_2$-in. 10-spline shaft is provided for straight-line drives with a universal joint. If it is desirable to use sprockets, pulleys, or gears on this model, they should be independently supported in outboard bearings.



The model 12-A has a flanged output shaft and an SAE No. 3 flywheel housing at the rear. This design permits the installation of a second flywheel, automotive clutch, and mechanical transmission.

The new converter couplings are proving successful in tow trucks, front-end loaders, route-delivery trucks, travel-loaders, hoists, yard and mine locomotives, logging yarders, and other industrial materials-handling installations where start-and-stop, heavy-load pickups are hard on engine, gears, drive lines, axles and tires, and tiring on operators.

Features of this Fuller Torque Converter design are: (1) no external oil pump or piping for normal operation, (2) low oil pressure which protects seals, (3) self-contained cooling system under normal operating conditions, (4) fits commercial engines with SAE No. 3 flywheel housings, and (5) flexible driving disk which corrects for slight misalignment.

Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Manually Operated Bender

A new hand-operated bending machine which bends up to 1-in-diam cold-finished steel bar and $1^1/_4$-in. tubing or their equivalents has been added to the Di-Acro line of precision metalworking machines manufactured by O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn.

Designated Di-Acro Bender No. 4, it is designed for heavy bending operations where production does not warrant a power-driven machine. It offers a radius bending range from 0 to 12 in.

A feature of the machine is a built-in ratchet mechanism which can be engaged or disengaged by the operator depending upon the size of the material being formed. Engaging the ratchet mechanism increases the material capacity of the bender—larger and heavier size material can be bent—and multiplies the operator's effort by approximately four times.

By disengaging the ratchet—operating the bender in direct drive—the operator can step up the production of lighter materials.

Di-Acro Bender No. 4 can be quickly changed over from one forming operation to another. It provides a method of producing one or many, simple or complicated parts without the cost of dies.

A special stand is available for the bender as is a complete line of accessories for bending, tubing, angle, channel, extrusions, moldings, strip stock, bus bars, round or square rods, and other solid, ductile materials.

Spirol Pin

A new fastening principle has been incorporated in the design and construction of a newly developed Spirol pin.

Spirol pins are machine pins which have been engineered especially to overcome the inherent shortcomings of fastening pins. They are formed by rolling strip steel spirally. The spiral cross section makes the pin unique, and provides the pin with its many desirable features. The pin is a coiled spring whose physical properties can be changed by varying the thickness of the strip, the tightness of the coils, and the number of coils in the spiral.

The many advantages that Spirol pins have are the result of their spiral cross section. An infinite number of pins with different physical properties can be made, ranging from a strong and rigid pin to a weak and flexible pin. The force required to insert the pin can be varied so that one pin will require heavy pounding while another can be inserted merely by pressure of the thumb.

Spirol pins are used in holes drilled with standard drills with no reaming, which saves money, time, and tools. While standard Spirol pins are made from strip steel and are heat-treated, Spirol pins can be made from other materials such as stainless steel, brass, aluminum, and other flexible materials.

Spirol pins are designed and are being produced by the C.E.M. Co., 24 School St., Danielson, Conn.

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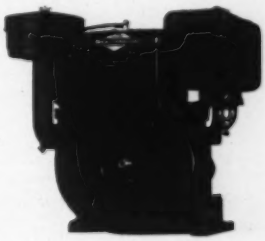
Near you there is a Briggs & Stratton service organization — factory trained and supervised — ready to tune up, repair, or even rebuild your Briggs & Stratton engines with *original* Briggs & Stratton parts.

If your Briggs & Stratton engines are not busy during these winter months, now is the ideal time to have them serviced — to insure continued peak performance for busy periods ahead.



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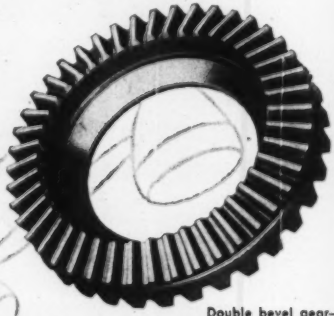
We are proud of our craftsmen, proud of our gears, proud of our reputation for quality. And we are proud of the fact that our customers can deal with us with complete confidence—an established, reputable firm with whom you, too, will enjoy working.



Double bevel gear—used in post hole digger

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Helical	*Coniflex Bevel
Worm	Spiral Bevel
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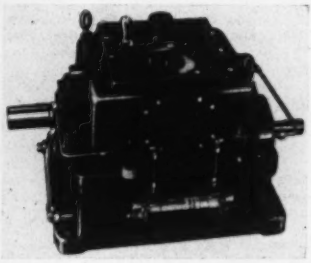
LATEST CATALOGS

Change Speed Unit

After 20 years of constructing change speed units to individual specifications, Philadelphia Gear Works, Inc., Philadelphia, Pa., has introduced a standardized line of these units. These are designed and built to eliminate the high cost and delayed delivery of specially built units.



These new Philadelphia standardized units are positive, reliable geared drives, using herringbone gears throughout—and they provide definite ratios of speed reduction, speed increasing, or a combination of both. There are no belts to wear out and cause speed variations. They are available in 2, 3, and 4-speed combinations, in a wide range of ratios and horsepowers for speed reducing, speed increasing, or a combination of both.

Projection Positive Paper

A new photographic paper for the production of positive paper prints either through reduction or enlargement has been announced by the Eastman Kodak Co., Rochester, N. Y.

The new paper, known as Kodagraph projection positive paper, can be used in a process camera to make direct reduction positives from large drawings, or it can be used with an enlarger to produce positive prints from positive microfilm records. The former application is in line with the trend to produce smaller prints of engineering drawings. These prints, experience has shown, are just as legible and easier to handle than the typical large bulky drawing. They also require less material.

The ability of this new paper to reproduce positive microfilm prints as positive enlargements is expected to be particularly helpful to libraries and other places which have considerable quantities of positive microfilm duplicates.

Kodagraph projection positive paper requires a special developer. It will, however, be available through all Kodak Industrial dealers.

New Graphitic Steel Product

The Steel and Tube Div. of The Timken Roller Bearing Co., Canton 6, Ohio, announces a new graphitic steel product which will carry the trade name "Graph-Mo Hollow-Bar." This new product is a turned and bored bar section using for the basic material the familiar Graph-Mo tool steel which Timken has been marketing for more than 15 years.

This new product will have all of the advantages of graphitic-type tool steel plus the convenience of the hollow bar section in manufacturing ring gages, dies, and other annular tool-steel parts.

The material will be stocked in 15 cities throughout the country. Stock sizes will range from about 4 in. to 16 in. OD with a variety of wall thicknesses. Present distributors for "Graph-Mo Hollow-Bar" are A. Milne and Co. and Peninsular Steel Co. Stocks will be located in New York, Boston, New Britain, Philadelphia, Buffalo, Pittsburgh, Cleveland, Akron, Dayton, Toledo, Detroit, Grand Rapids, Indianapolis, Chicago, and San Francisco.

Hydraulic Fork-Truck Attachment

A newly designed diverter valve announced by the Industrial Truck Div. of Clark Equipment Co., Battle Creek, Mich., makes possible for the first time economical installation in the field of a number of special hydraulic attachments.

By means of the valve, the truck's hydraulic system for tilting the upright can be utilized to operate the special hydraulic attachment, using the standard tilt lever as the means of control. When the diverter valve plunger is in the "up" position, oil is diverted to the attachment. When the plunger is in the "down" position, oil flows to the tilt cylinders, and the truck operator has normal control of tilting. Simultaneous operation of the attachment and tilt cylinders is impossible.

The new valve offers advantages in situations where installation of an auxiliary valve, for a hydraulic device would ordinarily be too costly or time-consuming; or in the case of old models where major modification would be necessary, making field installation impossible.

Split-Flange Type Clamp

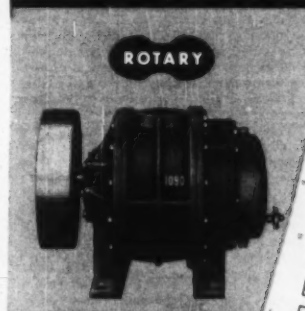
The Anchor Coupling Co. Inc. of Libertyville, Ill., has announced the development of a new split-flange type clamp. This exclusive clamp design represents an important new development for the hydraulic field, because (1) it is easy to use, (2) it eliminates threaded joints, and (3) it prevents leaks.

A wide selection of sizes is available for use with either clamp or pressed-on type couplings in straight or angle styles for one or two-wire braid hose from $\frac{1}{2}$-in-ID through 2-in-ID.

The clamp is extremely versatile and can be used for high, medium, or low-pressure service, suction return lines, etc.

Moreover, assembly is easy. No big pipe wrenches are needed. All that is required is a small, convenient, automotive-type wrench.

For 10 CFM or 100,000 CFM
...compare blower values



Typical low-capacity R-C Rotary Positive Blower. Sizes range from 5 cfm to 50,000 cfm, permitting selection closely matched to needs.

- ☐ Choice of Rotary or Centrifugal
- ☐ Capacity matched to the job
- ☐ Easy accessibility
- ☐ Ruggedness
- ☐ Ease of installation
- ☐ Ability to handle overloads
- ☐ Long-time durability
- ☐ Freedom from breakdowns
- ☐ Low maintenance costs
- ☐ Engineering assistance
- ☐ Proved reputation of maker
- ☐ Customer satisfaction

No need to take chances when buying blowers, exhausters or gas pumps. Just put this "detector test" to work on your specific problem and you'll arrive at the most satisfactory answer.

For instance, if you're debating between Rotary Positives and Centrifugals, remember that only Roots-Connersville builds both—the exclusive *dual-ability line* that permits unbiased recommendations. Their wide range of capacities supplies sizes and types that are quite likely to be most closely matched to your needs.

For economy of operation, reliability and low maintenance, we refer you to a list of users that dates back almost a century. If you'll rate your possible choices on a performance basis, you'll usually find R-C equipment "tops" on the list.

To help you make the most profitable, practical decision, our experience is at your service.

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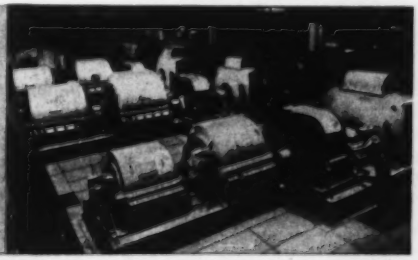
CENTRIFUGAL



Six R-C Multi-Stage Centrifugal Blowers equipped with automatic regulators to provide extremely wide range of operation at various pressures and capacities.

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We have compiled 154 case-histories of successful applications of molybdenum sulfide to solve a wide range of industrial and technical problems; these are published in a form most useful to those who want practical information on what has already been accomplished by this new kind of lubricant.

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This means greater clearance, no strain, less effort, and the elimination of thread compounds.

The seal of this revolutionary type of clamp consists of an O-ring, which has proved so successful in countless hydraulic applications. This perfect static O-ring seal eliminates the need for tapered threads. There is no wedging action to cause distortion in valve bodies, cylinders, or any other piece of hydraulic apparatus.

This new Anchor clamp provides an unusually strong connection. In this exclusive design the bolt centers are located to evenly distribute the forces and prevent tilting of the clamp halves. The ribber clamps are structurally strong to withstand pressures of high pressure hose. This feature alone helps maintain a permanent, leakproof seal so that the split-flange type clamp is ideally suited for the toughest kind of service.

240,000-lb Drum

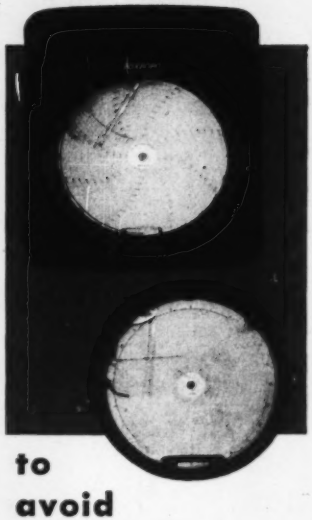
A 240,000-lb drum, 50 ft in length, for a Combustion Engineering-Superheater, Inc., steam-generating unit is shown being installed at the Joppa Steam Station of Electric Energy, Inc., Joppa, Ill. This drum has a 70-in-OD and one of its sections was rolled from steel plate having an initial thickness of $6^3/_{32}$ in. These steam-generating units, six in number, are intended to furnish power for an Atomic Energy Commission project located near Paducah, Ky. They each have a maximum continuous rating of 1,200,000; lb per hr of primary steam at 1925 psig and 1055 F, and 1,110,000 lb of reheat steam at 489 psig and 1005 F. The plant designed and built under the direction of Ebasco Services, New York N. Y., is of semi-outdoor construction.

Portable Compressors

Ingersoll-Rand rounds out its line of Gyro-Flo portable compressors with three sizes in addition to its 600-cfm model. The introduction of 315, 210, and 105-cfm units makes the advantages of the rotary sliding-vane design available for a wide range of operating requirements. Major benefits claimed by the manufacturer are simplicity and low cost of operation and maintenance, and greater reliability. Smaller dimensions, greatly reduced weight, and discharge temperatures at least 100 deg lower than conventional portables are other important advantages.

The two-stage, oil-cooled, rotary sliding-vane compressor design of the Gyro-Flo machine eliminates most of the problems of

TEMPERATURE RECORDERS



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Accurate Foxboro Temperature Recorders give you a minute-by-minute report of process conditions — an invaluable aid in determining future operation. Moreover, the records forecast impending difficulties — permitting corrections to be made before costly trouble starts.

Available with vapor pressure, gas pressure, or liquid expansion type systems. Choice of 50 standard bulbs; 700 chart ranges and scales from −450° to +1000°F. Round or rectangular cases for all operating conditions. Exclusive Foxboro design and construction advantages detailed in Bulletin 447. (Temperature indicators and controllers also available.) Write **The Foxboro Company, 9612 Norfolk St., Foxboro, Mass.**

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5. QUICK WARM UP
6. UNIQUE 0-100% ADJUSTABLE HEAT OUTPUT
7. ADDED SAFETY WITH VOLATILES
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9. EASY OVEN BUILDING
10. SPACE SAVING

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☐ Send me Catalog 50 which shows other Chromalox Units.

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reciprocating units for portable service. There are no valves to leak, no pistons, rings, rods or clutch to wear. Air, discharged at less than 200 F under normal operating conditions, together with thorough oil separation, eliminates hose deterioration caused by heat and oil. The continuous rotary action provides a steady flow of air without pulsations or vibrations.

It is equipped with "Air Glide" Capacity Control, a stepless system that controls the air output smoothly over the full range from 0 to 100% capacity. This combines variable intake unloading of the compressor and "floating speed" control of the engine. Throughout the entire capacity range the air pressure stays between 100 and 110 psi, assuring uniform work and more work done by drills and other air tools.

The 600-cfm model is powered by a General Motors Diesel engine. The 315 and 210 cfm sizes offer a choice of either GM diesels or Continental Red Seal gasoline engines. The 105 uses a Continental gasoline engine.

Gyro-Flo portables are easy to maneuver in the roughest terrain because they weigh up to 40% less than reciprocating machines of equal capacities. For instance the 600-cfm model weighs only 9500 lb and the 105 only 2630 lb—ready to go.

Further information is available from Ingersoll-Rand Co., Dept. PC, 11 Broadway, New York 4, N. Y.

Test Gage

A periodic check of pressure instruments with a reliable test gage has been known, in many instances, to save process fluid or otherwise reduce operating costs in amounts many times the cost of the test device. Such an instrument is the 6-in. model P test gage, made by the Foxboro Co., Foxboro, Mass. This inexpensive gage not only serves in checking pressure controllers, recorders, and indicators, but also furnishes a standard of accuracy for calibrating other pressure-testing equipment in the instrument department.

The 6-in. test gage is furnished in ranges of 0–30 Hg vac. up to 0–10,000 psig, and guaranteed accurate within $\frac{1}{2}$ of 1% of the total scale at any point throughout its range. Suitable tapered pipe male thread connections are provided.

Construction is of specially selected materials. The case is cast aluminum, threaded to receive a brass ring which is finished to match the case. The measuring element

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is a full 270° Bourdon spring of steel or beryllium copper. The movement consists of a chrome-plated steel pinion, segment and arbor, monel plates, and a stainless-steel hairspring. A stainless-steel micrometer-adjusted pointer facilitates precision measurements on an easy-to-read dial. A durable leather carrying case, with shoulder strap, is optional.

The complete series of indicating gages and accessories is described in Foxboro bulletin No. 424.

Portable Roller Conveyers

A new line of lightweight portable roller conveyers has been added to the list of Pre-engineered materials-handling equipment by Mechanical Handling Systems, 4601 Nancy Ave., Detroit 12, Mich.

This new series of roller gravity conveyer carries the No. 2520 which indicates a $2^1/_2$-in. channel and 2-in-diam rollers. The frame is composed of a $2^1/_2$-in channel of 12-gage material secured by four cross braces, of $1^1/_2 \times 1^1/_2 \times {}^3/_{16}$ in. angle iron. The rollers are 2-in. diam, 12-gage, with formed ends and receive a machine bearing. This type bearing gives superior service over the stamped bearing which is usually associated with lightweight roller conveyers.

The No. 2520 series of MHS roller gravity conveyer is available in 12, 16, 18, 20, and 28-in. widths with rollers on multiples of 3 or 4-in. centers.

The frame capacity of a 10-ft section is 500 lb with the individual roller capacity 125 lb.

Over 85% of the torque wrenches used in industry are
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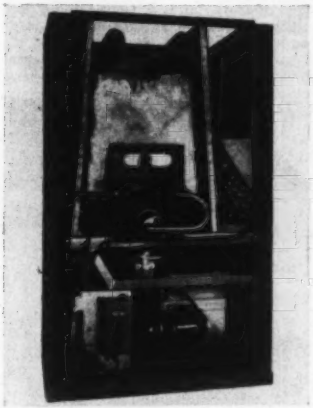
Air-Conditioning Unit

A new low-priced, complete year-round air-conditioning unit, designed specifically for the $10,000 and up mass home market and for vast numbers of existing homes in this country, was introduced by Carrier Corp. in New York, N. Y., recently.

The new Weathermaker will easily handle the year-round cooling and heating job in the average low-priced, three bedroom home in any area of the country. It requires minimum floor space—about 3 ft × 3 ft—and is ony a little more than five feet high.



While retail prices of the new unit will vary with the amount and local cost of installation work required, Carrier's price to its distributors will be about 25% less than the current smallest Weathermaker unit.

If installed in an existing home under an FHA modernization loan, payments would be about $20 to $30 a month additional for 3 years over the cost of forced warm equipment alone. This new unit is entirely sound-proofed and heat-proofed. It can be placed in a small closet in the middle of the house, saving on duct work, or in the cellar, garage, or even attic.

New features include heating with any type of gas, or with oil. For those sections of the country where water is in short supply or is expensive the unit is available with air-cooled refrigerant condensing which does away with the need for water or for a cooling tower.

The home Weathermaker cools the home and removes excess humidity in the summer, heats it in the winter and provides year-round circulation of fresh, clean, filtered air. Both heating and cooling are controlled simply by the flick of a switch, either on the unit or from a separate thermostatic control anywhere in the house. All sections of the unit can be reached from the front by the simple removal of a panel. Air enters the unit from either the side, back or bottom and can be distributed through the house in any of four directions. This provides the greatest flexibility of installation of any air conditioning unit now available.

The new unit's two tons of refrigeration capacity are enough for average three-bedroom homes up to 1200 or more sq ft in size in any climatic areas. Other Carrier residential year-round units are available in 3-ton, 5-ton, and 7½-ton sizes.

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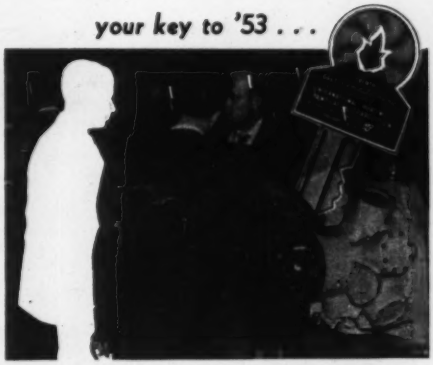
. . . to see and learn about the latest developments in . . .



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Nicholson Expansion Steam Traps

SAVE $155 PER UNIT

for Large Processor

Because of their positive effectiveness in temperature control work, Nicholson expansion steam traps, at about $35 each, are being installed by a leading processor in place of temperature controls. These were costing them $110 to $200, with cost of trap added. Per installation, the saving is about $155.

This firm is finding an increasing number of applications on tanks, stills, heating radiators, etc., where Nicholson expansion steam traps are serving as both trap and temperature controller.

Because there is only one moving part, remarkably low maintenance costs are being shown. Easily installed, usually without supports. Lengths, 9" to 40". Pressure, 0 to 250 lbs. No air binding.

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If you manufacture any of the following transportation equipment or supply component parts or assemblies, Lord Engineering can help you:

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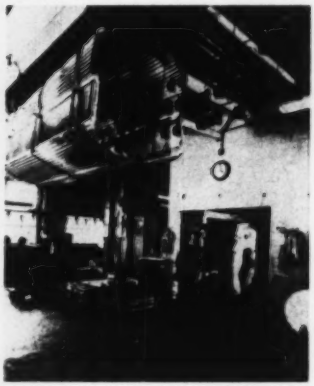
Far-Infrared Oven

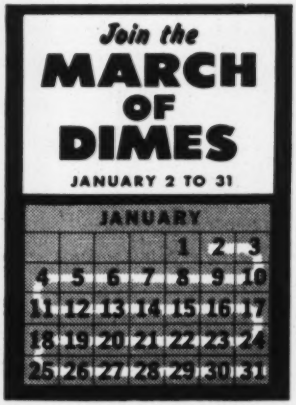
A new far-infrared oven at the Foxboro Co., Foxboro, Mass., bakes paint on 22,000 separate meter parts in an eight-hour shift. Consisting of only four aluminum Chromalox radiant heaters and reflective aluminum sheeting, the lightweight oven is conveniently located overhead to save valuable floor space.

All colors of paint are baked at about the same speed using the far-infrared heaters. No slow-up is necessary to accommodate light colors as usually would be the case with ordinary infrared lamps. Since the radiant heat is directed and reflected into the work rather than convected around it, it has not been necessary to close the ends of the oven.



A flexible conveyer system permits easy handling of both large and small parts. Small items are hung on frames with three tiers, while larger ones are attached directly to the main conveyer hooks.

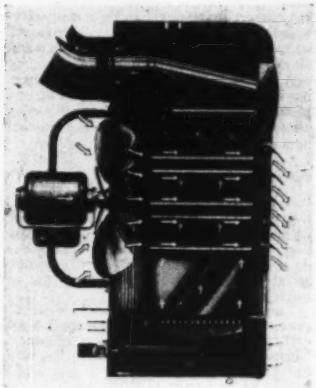
Total installed capacity of the oven is 14.4 kw on a 230-volt line. Conveyer speed is 4½ fpm. Further information available from Edwin L. Wiegand Co., 7646 Thomas Boulevard, Pittsburgh 8, Pa.



Gas-Fired Unit Heaters

The Trane Co., La Crosse, Wis., has introduced a new, streamlined line of gas-fired unit heaters. Six units range in capacities from 50,000 to 230,000 Btu per hr input.

Heart of the new, competitively priced design is the heat exchanger, "built like a boiler" with its horizontal steel tubes staggered to provide maximum areas of prime heat surface. Generously sized for smooth, quiet air passage, the steel tubes are rolled into heavy end sheets, boiler tube style, and are fortified with additional outer and inner rolled flanges. No cement or gaskets are used in the heat exchanger's locked seam construction. Airtight operation is assured by the continuous seam welding of end plates to sides. A brush can be passed between the tubes for easy cleaning.



The heat generator includes burner heads and mixing tubes of one-piece cast-iron construction. They are engineered for efficient combustion of natural, manufactured, mixed, or liquid-petroleum gas. Burners, pilot, and control valves are combined in one removable drawer-type assembly for easy maintenance. Built-in safety controls include a high-limit switch to prevent overheating, and automatic cutoff of both pilot light and main gas supply. An integral draft diverter allows back and down drafts to by-pass the burner assembly without affecting normal operation.

Monotube Dryer

Economical drying and cooling—and a new means of obtaining by-products and recovering solvents—are three of the functions of a new Monotube dryer developed by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill.

The Monotube dryer operates on the conduction principle of heat transfer. There are no air currents through the material bed. Dusting is practically eliminated, and it is possible to dry materials having fine particles which readily become air-borne. Materials as light and fluffy as cake flour and cottonseed meal can be dried successfully.

The dryer is made in two trough diameters—24-in., in lengths from 5 to 10 ft, and 30-in. in lengths from 5 to 20 ft.

Boiling Nitro-Cellulose

in HORTON Stainless Steel Tubs

The above view shows some of the eighteen field-erected solid stainless steel tubs we built at an ordnance works for boiling nitro-cellulose. They are flat-bottom structures, 18 ft. in diameter by 12 ft. deep and have extra false bottoms supported on stainless castings.

The shells and bottoms are made of Type 347 stainless steel and the tops of Type 321 stainless steel. The false bottoms and supporting castings are Type 304 stainless steel.

These tubs for boiling nitro-cellulose are another example of our versatility in the building of steel plate structures for use in all types of industries. They were fabricated in one of our four strategically-located plants and erected by one of our own experienced field crews.

In addition to solid stainless steel structures, we are equipped to handle all types of corrosive-resistant metals, clad steels and linings. We also have complete facilities for x-raying and stress-relieving and have recently enlarged our facilities for pickling and painting metal plates by the Horton phosphoric acid process.

Whether you require specially fabricated structures, flat-bottom tanks or elevated water tanks—write our nearest office for quotations. There is no obligation on your part.

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Because of:

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Dual, opposed inlet and exhaust porting provides radially balanced operation.

Hydraulically Balanced Vanes

Less load on cam ring . . . low loading characteristics at all operating pressures.

Simplified Design

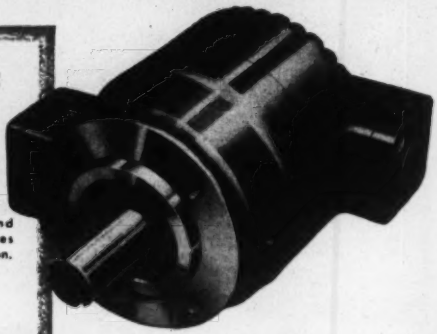
Consisting of only three ruggedly built, close-coupled components. Pump/Motors assure extra stamina.

Highly Compact Construction

Delivering 7.5 gpm at 2000 psi, this typical Pump/Motor is only 4½" in width and height; only 8" long *including the shaft.*

Bi-directional Rotation

All Pump/Motors are quickly and easily convertible to counter-clockwise rotation, and operate with equal efficiency in either direction.



DENISON PUMP/MOTORS—*ready for either pump or motor use without alterations of any kind*—are designed and built to stand up longer, at full efficiency, under a wider range of applications calling for hard, continuous duty at 2000 psi.

Some of the features that give Pump/Motors this extra value are shown at left. In addition, their 3-unit construction makes it easy to alter the relation of inlet and exhaust porting for easiest installation. For better valving action, the heavy-duty Pump/Motor vanes feature dual, precision-machined sealing edges held in constant contact with the cam ring.

FOUR SIZES, each with a choice of interchangeable cam rings, offer pumping capacities from 2.7 to 70 gpm . . . or motor torque capacities from 13 to 257 pound-inches per 100 psi. *For smoother, longer-lasting, low-maintenance operation, specify Denison Pump/Motors.* Write for full details.

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PUMP/MOTOR

There is only one moving part—a paddle conveyer on a hollow shaft, which turns in a U-shaped trough or housing.

Steam, hot liquid, or coolant circulates through the shaft and outrigger tubes, producing efficient transfer of heat as the material is churned and conveyed through the trough. Constant agitation assures uniform drying without overheating.

The Monotube dryer is effective in treating a wide variety of chemicals, pharmaceuticals, food and vegetable oil mill products, and many other materials. It operates equally well at high or low temperatures.

It can be used for products which must be dried at temperatures above or below that of steam, merely by using another medium, such as hot water for lower temperatures and hot oil or other liquid for higher temperatures. It can also serve as a cooler by using water, refrigerants or other cooling media.

By the process of condensation, this dryer can extract by-products and solvents otherwise lost in processing. The solvent in the wet solids is carried out of the dryer by warm air and cooled beyond the dew point.

A new Book No. 2413, describes the dryer, its field of application, and results accomplished in actual installations, together with photographs, drawings, and dimensional data.

Back-Up Ring

A new-type spiral back-up ring for "O" ring seals for hydraulic service, that will not shrink, swell, harden, or soften, is in production by W. S. Shamban & Co., Los Angeles, Calif. Made of teflon the new spiral packing is said to be far superior to types currently used.

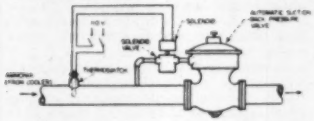
The Shamban packing, known as Kelon-T, protects the "O" ring seal indefinitely from extrusion, deterioration, or loss of efficiency. Chemically inert, the new packing has very low friction and is unaffected by oils, acids, bases, or solvents. Useful temperatures range from − 110 F to + 500 F.

Shamban Kelon-T spiral packings are used most often as back-up rings to extend the life of rubber "O" rings in hydraulic and pneumatic cylinders, presses, pumps, and valves. Hydraulic engineers and designers are finding many new aircraft and industrial applications for the new packing. It is possible, in some applications, to seal effectively without "O" rings if the packing completely fills the groove in one continuous spiral of several layers. Sizes of standard Shamban Kelon-T spiral packings range from 0.125 to 15.50 in. ID, and correspond with sizes of standard "O" rings. The rings are available in 153 sizes. Special sizes available on order.

For design information write, W. S. Shamban & Co., Dept. K, 5747 Marilyn Ave., Culver City, Calif.

Safety Thermostat

A low temperature safety cut-off in an ammonia-cooled heat exchanger prevents freezing and possible spoilage of the product if the regular temperature controller permits the temperature to fall too low. The cut-off action is provided by an inverse Thermoswitch, a precision thermostat manufactured by Fenwal Inc., of Ashland, Mass. As shown in the accompanying diagram, the safety thermostat is placed in the line from the cooling unit where it can sense the temperature of the coolant before it enters the heat exchanger.



Ammonia is circulated through the system by suction. The Thermoswitch is wired in series with a solenoid which controls the action of an ammonia back-pressure valve. At normal operating temperatures, the thermostat contacts are open, permitting the back pressure valve to remain closed. When the temperature drops to the danger point, the thermostat contacts close and trip the solenoid. This forces the valve to open, destroying the suction in the line. The coolant then ceases to circulate until the temperature returns to normal levels. Thereupon the thermostat will again de-energize the solenoid, restoring suction in the line. Usually, the safety thermostat is also wired to an alarm circuit to warn the operator of the abnormal condition.

Ball-Bearing Torque Tester

A new device for measuring torque transmitted through small instrument ball-bearings under thrust loads, has been announced by the Special Products Sales Section of the General Electric Co.

Designed to act as a quality control check in both production-line and laboratory work, the new tester is able to show how the torque of a small ball-bearing varies as a function, of angular position during a continuous slow rotation in either direction.

Basically, the equipment determines bearing torque by measuring the current drawn by a torque motor in counterbalancing the bearing race torque as indicated by an electromagnetic pick-up.

According to engineers, the ball-bearing torque tester will save many man-hours of assembly and disassembly by making possible the detection of dirty or defective bearings before their installation in an instrument. Number and magnitude of peaks average friction, and tendency to bind under load all can be determined, they said.

In operation, the bearing to be tested is inserted in an adapter and both are then mounted in the tester. The inner race is clamped to the shaft of the device and the outer race is rotated one revolution in either direction by a drive motor.

Torque from the outer race is transmitted through the ball bearings to the inner race and shaft, tending to rotate the shaft assembly and angularly displace an electromagnetic pick-up. A signal, proportional to this displacement, is generated in the pick-up and delivered through an electronic circuit to a torque motor. The motor, in turn

SOUTHERN RAILWAY SYSTEM
Builds South's Largest Freight Yard in the BIRMINGHAM DISTRICT

Birmingham's position as the South's transportation and distribution center has been reinforced and vastly amplified by the recent completion of the Southern Railway System's new multimillion dollar Ernest Norris freight classification and forwarding yard. This newly-opened freight yard is the most modern in the world and largest in the South. It affords complete facilities of the very latest "push button" type for rapidly receiving, classifying and forwarding cars and for running repairs to Diesel locomotives and cars.

The new yard occupies a 500-acre tract, six miles from downtown Birmingham. It contains 92 miles of track, capable of handling 2,533 cars at one time.

Speaking recently in Birmingham about this great development, President Harry A. DeButts said:

"This is one of the most important projects ever undertaken by our railway. Construction of the new yard was dictated by the heavy increase in traffic volume in the Birmingham area and the surrounding Southeastern section of the U. S. A. It is an expression of our confidence in the continuing industrial development of the fast-growing Birmingham district. This new yard now makes available some very choice industrial sites on our Birmingham property. Information about these will be furnished on request."

★ ★ ★ ★ ★ ★ ★ ★

The Birmingham Committee of 100 or any of the undersigned members of its Executive Committee invites inquiries from those interested in the establishment of industries, warehouses or branch offices in the central Birmingham district, from which growing Southern markets can be served most rapidly, advantageously and economically.

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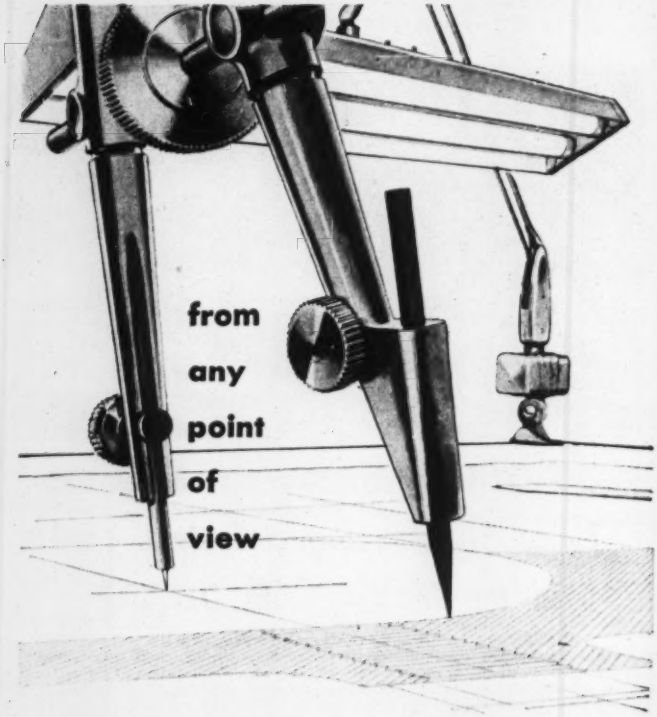

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generates a counterbalancing torque, and, since the two forces tend to equal each other, the motor current is a reliable measurement of the transmitted bearing torque.

With the new tester, complete torque information is obtained in less than two minutes. The data can be either recorded on a recording milliammeter—which will give a complete picture of the torque—or indicated on a microrelay—a "go-no-go" gage. When the microrelay is used, any torques higher than a selected maximum will energize the microrelay to lock-in position and will indicate by means of a signal lamp that the selected value has been exceeded.

Designed to accommodate most bearing sizes commonly used in gyroscopic instruments, the mechanical unit is $6 \times 9^1/_2 \times 6$ in. and weighs $13^1/_2$ lb. The electronic unit is $17 \times 8^1/_2 \times 9^1/_2$ in. and weighs $21^1/_2$ lb, and the recorder, optional with the tester, is $10 \times 13 \times 11$ in. and weighs 35 lb. The equipment operates on 115 volts, 60 cycles.

Additional information on the ball-bearing torque tester may be found in publication GEA-5822, which is available from G-E, Schenectady 5, N. Y.

Business Notes

Eastman Kodak's DPI Equipment Mfg. Business To Be Sold To Consolidated Engineering

Negotiations for the sale of the equipment manufacturing portion of Eastman Kodak Company's Distillation Products Industries division to the Consolidated Engineering Corp. were announced in a joint statement by Eastman Kodak at Rochester, N. Y., and Consolidated Engineering at Pasadena, Calif. Transfer of the business is expected about Jan. 1, 1953. DPI's distillation operations and its business in vitamin concentrates and synthetic chemicals are not involved in the sale.

Combining Consolidated's extensive research and development program with DPI's Vacuum Equipment business will give Consolidated a leading position in the vacuum equipment field, as well as in the electronic, it was pointed out.

Johns-Manville To Develop New Asbestos Mine

Johns-Manville, which operates two asbestos mines in Canada, one of them the world's largest, announced plans for the development in Africa of a third asbestos mine.

The new asbestos ore properties are located at Mashaba in the Victoria District of Southern Rhodesia, about 200 miles south of Salisbury and 120 miles east of Bulawayo.

The project is part of Johns-Manville's long-range program to maintain adequate supplies of asbestos ore for many years to come.

The plans call for development of the asbestos ore properties of Rhodesian Asbestos Ltd. and construction of a small central mill to process asbestos bearing ore extracted from the mine.

Keep Informed

NEW EQUIPMENT
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Ellison Moves to Larger Quarters

The Ellison Draft Gage Co., Inc., manufacturers of gages and instruments widely used by combustion engineers, ventilation engineers, scientific laboratories, automotive and aircraft engineers, has moved to modern, larger quarters at 548 W. Monroe St., Chicago, Ill. The firm was formerly located at 214 W. Kinzie St., for nearly 50 years.

Du Mont Expands Southwest Sales-Service

Expansion of sales service in the Southwest by the Instrument Div. of Allen B. Du Mont Laboratories, Inc., was disclosed with the anouncement that Gates Co. of Salt Lake City, Utah, the Divison's sales representative in the Rocky Mountain area, has opened a branch office in Albuquerque, N. M. at 110 Harvard Drive, S.E.

The Albuquerque branch was being opened at a time when the electronics field in the Southwest was entering upon its biggest era of expansion. The new office would enable Du Mont to serve the Southwest area more efficiently and furnished an answer to the growing need for electronic test equipment in that area.

Westinghouse Completes New Tube Plant

Completion of all building construction for the new Westinghouse electronic tube plant and division headquarters at Elmira, N. Y., was announced by Westinghouse Electric Corp.

Located on a 114-acre tract four miles northwest of Elmira, the plant houses headquarters executive offices, engineering laboratories, two separate manufacturing areas, warehousing, and shipping. Of steel, brick, and concrete block construction, the building is fireproof and has a total working area of 365,000 sq ft.

To facilitate the precision manufacture of electronic tubes, cleanliness and ample light have been foremost considerations during construction. Fluorescent lighting, air conditioning, Precipitron electrostatic air cleaners, cellulose acoustic ceilings, and asphalt tile floors have been installed.

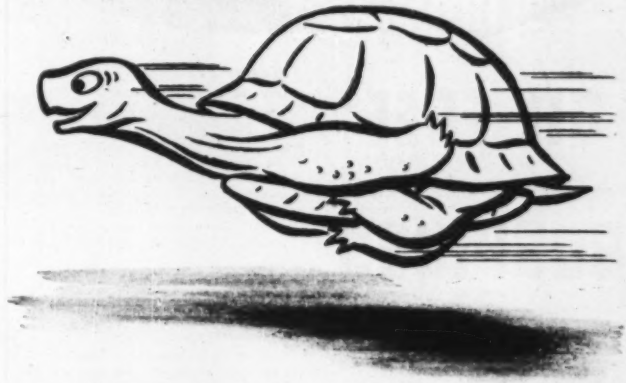
Products to be manufactured in the new plant will include television picture tubes for home use and classified government use, and also transmitting, industrial, and special purpose tubes for both commercial and military applications.

Westinghouse Air Brake Purchases Interest in Le Roi Co.

A joint announcement made by Westinghouse Air Brake Co., Wilmerding, Pa., and Le Roi Co., Milwaukee, Wis., reveals that Westinghouse Air Brake Co. has purchased a majority interest in Le Roi Co. On August 20 an offer was made to Le Roi stockholders to purchase common stock at $9 per share and preferred stock at $53.75 per share provided 400,000 shares of the 576,000 outstanding shares of common stock were deposited by September 15. Over 400,000 shares were so deposited and checks are being mailed to the holders of these shares. The offer to buy common stock at $9 per share is being held open and continued to October 15, 1952.

Le Roi Company, manufacturer of engines, portable compressors and rock drills, was founded in 1916.

SPEED ADVANCEMENT



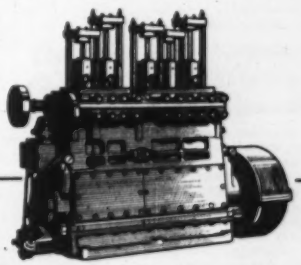
Aldrich did it with Direct Flow Pumps

Not too long ago, 150 rpm was considered high speed operation for reciprocating pumps. But today—as a result of improved design and stronger metals—Aldrich Direct Flow Pumps are operating efficiently at *or over* speeds of 500 rpm for the 3″, 360 rpm for the 5″, and 300 rpm for the 6″ stroke unit. This increase in speed means simply this:

You get more work—greater pressure and volume—out of a smaller pump. You invest in a lighter, lower cost unit . . . a pump with a *sectionalized* fluid-end that's extremely easy to maintain and which can be made of stainless steel, bronze, Monel or other special material, as desired.

Applications include: hydraulic systems for press operation; plastic and rubber molding and extrusion; steel mill descaling, and many uses in the petroleum and chemical industries.

Request Data Sheets on 3″, 5″, or 6″ Stroke Pumps for complete information.



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. . . Originators of the Direct Flow Pump

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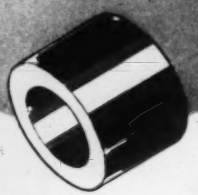
SELF-LUBRICATING
BUSHINGS



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Widely Used Where Ordinary Oil Lubrication Is Impractical or Impossible.

EXCELLENT DURABILITY • CONSTANT CO-EFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES **• OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE AND OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS**

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes etc.

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For applications requiring low electrical noise, low and constant contact drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

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1058 NEPPERHAN AVENUE • YONKERS, N. Y

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Mears-Kane-Ofeldt Becomes Div. of S. T. Johnson

Effective Aug. 6, 1952, the S. T. Johnson Co. of Oakland, Calif., and Philadelphia, Pa., advises that they purchased 100% control of the firm of Mears-Kane-Ofeldt, Inc., Bridgeport, Pa., who for over 50 years have manufactured gas and oil-fired high-pressure steam boilers—up to 30 hp.

This business will be operated and expanded as a division of the S. T. Johnson Co.

Allis-Chalmers Announces Norwood Works Expansion

Allis-Chalmers Mfg. Co. has purchased the plant of Victor Electric Products, Inc., in Cincinnati, Ohio to fill a long-felt need for additional space and shipping facilities for Texrope drive equipment. All Texrope sales, engineering, and production facilities will be moved into the new plant from West Allis. The newly acquired plant, two blocks east of Norwood Works No. 1, contains offices, cafeteria, manufacturing, warehouse, and shipping facilities in its 127,000 sq ft of floor space.

Pressed Steel and Downingtown Merge

Pressed Steel Tank Co., Milwaukee, Wis., and Downingtown Iron Works, Inc., Downingtown, Pa., issued a joint statement announcing the merger of the interests of the two companies through the acquisition by Pressed Steel Tank Co. of all the outstanding capital stock of Downingtown Iron Works.

The products of both companies are widely used by the LP-Gas industry, by the chemical, food, oil, and other industries. Pressed Steel Tank Co. produces the complete line of Hackney LP-Gas ICC cylinders in sizes from 5 to 420 lb capacity (Propane): Hackney LP-Gas fuel tanks for tractors, trucks busses, etc.; as well as air receivers and other pressure vessels in smaller sizes. Pressed Steel Tank Company also makes Hackney drums and barrels, and Hackney deep-drawn shapes and shells which are used as component parts in a great variety of manufactured products.

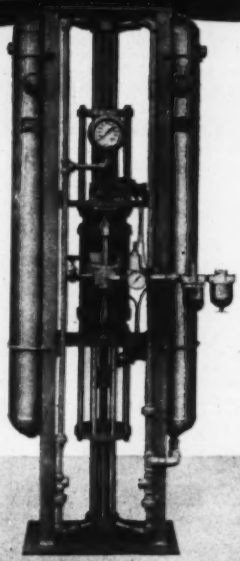
The products of both companies are made from steel, stainless steel, clad steel, aluminum, and other nonferrous materials.

Latest Catalogs

Nozzles

Builders-Providence, Inc., 345 Harris Ave., Providence, R. I. has issued a new technical bulletin, 135-J5 on the Kennison nozzle. This bulletin provides pertinent engineering information including accuracy, construction dimensions, installation, and, capacities of the Kennison nozzle. The bulletin describes some of the uses of the Kennison nozzle, e.g., measurement of the flow of liquids with and without the presence of suspended matter. The bulletin also presents other applications in industry. Made in sizes from 6 to 36 in., the Kennison nozzle is used with standard totalizing, indicating and recording instruments.

Ledeen
PUMPS



HIGH PRESSURE OIL
from
LOW PRESSURE AIR

Ledeen Heavy Duty Pumps and Power Units are built for operation of clamps, valve actuators, forming or drawing presses, safety installations, high pressure testing and other hydraulic circuits requiring adjustable pressure and volume and long pressure-holding cycles, without overheating the oil. Built as a complete package power unit, ready for easy installation, requiring connections only to incoming air line and outgoing hydraulic lines. Available in horizontal construction for minimum head room, and vertical construction for minimum floor space. Simple to install. Inexpensive to operate.

Write for Bulletin 4000

VALVES • CYLINDERS
AIR-HYDRAULIC PUMPS & BOOSTERS
VALVE ACTUATORS • AIR HOISTS

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Los Angeles 15, Calif.

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NEW EQUIPMENT
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LATEST CATALOGS

Flange and Coupling Selector

A revised edition of the popular flange and coupling selector, is available from the Nooter Corp., 1400 S. Second St., St. Louis, Mo., is now available to all engineering personnel upon request.

In the same easy-to-read slide-rule f m, it provides all the information contained in the earlier selector, plus new and useful data.

The flange size selector lists such relevant facts as the OD of flange, thickness, OD of raised face, No. of Holes, diameter of holes, diameter of bolts, bolt circle—for Series 15 and 30 Flanges.

The coupling selector shows average sizes of standard, extra heavy, 3000 and 6000-lb couplings. Also a convenient pipe standard table is incorporated on the selector, showing nominal wall thicknesses and weights per foot for schedules No. 5 to 160 as well as for standard, extra heavy, and double extra heavy pipe.

Electronic Combustion Control

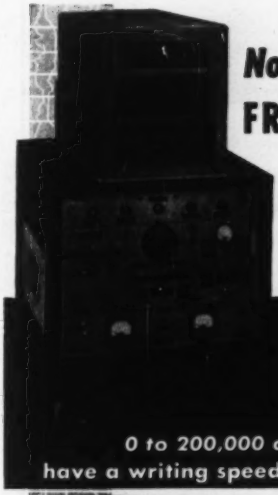
Brooke Engineering Co., Inc., announces the publication of an 8-page booklet describing the new Eyematic combustion control for oil-fired boilers. By utilizing an electric eye focused on a beam of light shining through the smokestack, the Brooke Eyematic combustion control regulates the fuel-air ratio to assure constant and maximum boiler efficiency. Included in the booklet is a schematic diagram of how the control operates, and photographs of the control panel and electric eye. Copies may be obtained by writing direct to Brooke Engineering Co., Inc., 4517 Wayne Ave., Philadelphia 44, Pa.

Carbide Tools

A new Kennametal catalog which has just been issued gives a complete picture of the variety, and range of sizes, of carbide tools currently available. In addition to industry standard Kennametal brazed tools this catalog lists blanks, new "top-clamp" Kennamatic tools, Kendex tools, Kennamills, and various specialties. Among the new tools shown are railroad shop tools, profiling tools, "KF" and "MF" Kennamills, and "heavy-duty" Kendex tools. These, along with the others are shown in various sections of the catalog, together with suggested applications. Available from Kennametal, Inc., Latrobe, Pa.

Flow Indicators

Bulletin 18-W, published by Schutte and Koerting Co., Dept. M-B, Cornwells Heights, Bucks Co., Pa., describes this company's line of flow indicators. These flow indicators are mechanical devices which indicate fluid flow and its direction in pipe lines by the position of a flapper or ball, or by the rotation of a wheel which can be directly observed through a sight glass or glasses. They are suitable for service with any kind of fluid—liquid, gas, vapor, slurry, or sludge, as long as the fluid is sufficiently translucent to permit observation of the indicating element. Currently, some of their uses include indication of flow of: coolant to the walls of chemical reaction vessels or furnaces; coolant to the active parts of electric machinery and transformers or to high power radio transmitter tubes; chemical solutions to apparatus in continuous processes; coolant to rock bit drills; and sludges or slurries in process operations.



No more worries about
FREQUENCY RESPONSE
or
WRITING SPEED.

The NEW and PHENOMENAL

HATHAWAY Type SC-16
OSCILLOGRAPH

with 6 elements is *flat from 0 to 200,000 cycles per second*, and its traces have a writing speed of *5 million inches per second.*

Fast transients and high-frequency phenomena now can be accurately recorded.

Several types of continuous-drive record magazines are available for 6-inch sensitized paper and film, and for 35-mm film. The magazine shown on the oscillograph at the left accommodates 100-foot rolls of record paper.

Drum-type magazines, both small and large, are valuable for short high-speed records. The large drum-type magazine at the left has a drum 3 feet in diameter and 6-inches wide. It can be driven at 3000 RPM for a *chart speed of 6000 inches per second* when high resolution is needed. It can be used to take one 10-foot record or a larger number of shorter records.

The ASC-10 6-element direct-coupled amplifier will drive the SC-16 oscillograph from potentials of millivolt level.

Useful for strain recording to 100 Kilocycles.

AUTOMATIC OPERATION Initiate a transient with the oscillograph, or let the transient start the oscillograph.

QUICK-CHANGE TRANSMISSION for wide range of record speeds.

PRECISION TIME LINES.

Z-AXIS MODULATION for timing to one-tenth millisecond.

QUICKLY-INTERCHANGEABLE LENS STAGES for different record and trace widths.

Write for Bulletin 2 GIN for details.

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NEW BULLETIN!

This important new Bulletin WH-851 explains in detail the causes and damaging effects of costly Water Hammer—and how it can easily be controlled with Williams-Hager Silent Check Valves. Learn how Water Hammer can be quickly and inexpensively controlled *in your piping system*—send for your copy of this new bulletin today.

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ME-1252

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Slasher Drives

A new bulletin, No. GEA-5711, describing multimotor packaged slasher drives for the textile industry is available from the General Electric Co., Schenectady 5, N. Y. The illustrated, four-page bulletin covers design and performance features of the G-E packaged slasher drive with amplidyne tension control. Maintenance factors and the G-E adjustable-voltage speed variator power unit are also outlined.

Pressure-Seal Valves

A 16-page catalog describing pressure-seal stop, check, and nonreturn valves has been issued by Edward Valves, Inc., Dept. NR, 1200 West 145th St., East Chicago, Ind. Separate spreads in the booklet give complete descriptions, design characteristics, and dimensional details on stop, check, and nonreturn valves. Each type is furnished in sizes from $2\frac{1}{2}$ to 14 in., and in 600, 900, 1500, and 2500-lb pressure classes. Tables and charts enabling readers to easily calculate the pressure drop in any Edward stop, check or nonreturn valve are provided to aid in valve selection. Complete material specifications, including detailed chemical analyses as well as physical characteristics are given.

Fractional Hosepower Air Compressors

Monobloc air compressors capable of 2.6 to 5.0 cfm and up to 150 psi pressure are the subject of a specification sheet No. H-605-B2, published by Worthington Corp., Harrison, N. J. These compressors are designed for pressure spraying; dry pipe sprinkler systems; operating pneumatic controls, presses, air cylinders, vises, small tools, etc.; tire inflation; pressure lubrication testing; cleaning; and general small capacity uses. Included are discussions of feather valves, aluminum cylinder head, deep finned cast iron cylinder, aluminum crankcase, counterbalanced crank, oversized main bearings, bronze precision fitted connecting rod, full floating steel wrist pin, and heavy-duty high-starting torque capacitor type motor.

Gear Materials

Modern Trends in Gear Materials—Part I, Nickel Steel & Cast Iron (20 pages); Part II, Two New Gear Materials (11 pages); illustrated, 23 tables, and 70 charts is available from International Nickel, Dept. EZ, New York 5, N. Y. Lucidly written for the purchaser of replacement gears, and for design and production engineers who are concerned with mechanical properties, ease of fabrication, and economy. Carburizing and direct hardening nickel alloy steels and low and medium silicon nickel gray cast irons are covered. Machinability and the effects of various types of heat-treatment are discussed. Characteristics of a precipitation hardening nickel steel, Nitralloy N, are reviewed. Recently developed ductile iron is evaluated as offering a new material that combines many of the advantages of steel and gray iron. Its ability to be cast in intricate shapes, its excellent machinability and its elastic properties and ductility that approach those of steel suggest new designs will be forthcoming to take advantage of its unique qualities.

THOMAS
Flexible ALL METAL
COUPLINGS
FOR POWER TRANSMISSION
REQUIRE NO MAINTENANCE

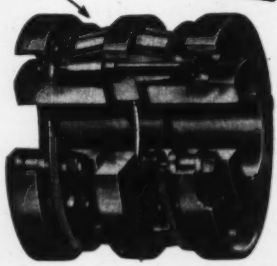
Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:
½ to 40,000 HP
1 to 30,000 RPM

Specialists on Couplings for more than 30 years

BACKLASH
FRICTION
WEAR and
CROSS-PULL
are eliminated
Lubrication is not required!

PATENTED FLEXIBLE DISCS



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

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WARREN, PENNSYLVANIA

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NEW EQUIPMENT
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Boiler Tube Corrosion

Corrosion as a major factor in shortening the life of boiler tubes is thoroughly discussed in an illustrated article published by The Tubular Products Div. of The Babcock & Wilcox Co., Alliance, Ohio. The article, TR-514, indicates that, in low-pressure boilers corrosion is the largest single cause for replacement of boiler tubes. It points out the various types and causes of corrosion and offers a number of general rules to follow to get maximum service life for boiler tubing.

Centrifugal Pumps

Ingersoll-Rand has released a new bulletin covering general-purpose centrifugal pumps of the cradle-mounted type. The bulletin covers 5 basic cradle groups and 17 corresponding pump types, their capacities, horsepower ratings, and uses. There are also two pages covering pump dimensions and a table of performance under 60-cycle use. In addition, two pages describe special-purpose units and design modifications. Copies of this bulletin, form 7223, are available from Ingersoll-Rand Co., Dept. C.P., 11 Broadway, New York 4, N. Y.

Expansion Joints

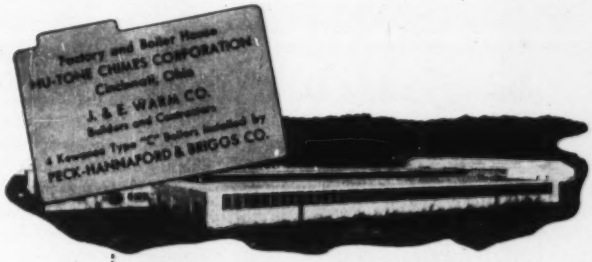
The recently redesigned Flexon line of expansion joints is featured in a new 16-page illustrated two-color catalog, No. CMH-128, released by Flexonics Corp., 1305 South Third Avenue, Maywood, Ill. Complete specification and supporting data is given for new Flexon expansion joints, now offering increased traverse per corrugation. Also covered thoroughly is complete specification and application information for CMH corrugated and convoluted types of flexible metal hose, including couplings, flanges, nipples, and assemblies. Installation instructions are included.

Silent Chain

An industrial chain so tiny that five pitches make up less than an inch of chain is described and illustrated in a new book No. 2510 on $^3/_{16}$-in-pitch silent chain, published by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. The booklet includes photographs of typical applications in such machines as band saws, recording devices, portable planers, and motion-picture projectors. Although it is primarily a drive chain, an example of its use as a conveyer is shown. Tables, engineering data, and instructions for correct selection of chain drives are included.

Electrical Products

A 4-page, quick-reference bulletin, describing and illustrating its principal products, has been issued by the Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland, Ohio. The booklet, No. A-2703, gives capsule digests of Reliance precision built a-c motors from $^3/_4$ to 300-hp; heavy-duty Type "T" d-c motors from $^3/_4$ to 1000-hp; the all-electric Reliance adjustable-speed (V*S) drive for a-c circuits, from $^3/_4$ to 300-hp; electronic controls and regulators for this motor-drive system; and Reliance motor-generator sets, generators, and rotating-type regulators. Many functions and advantages of each product are included, service applications for which they are designed are indicated, and representative units illustrated.


Factory and Boiler House
NU-TONE CHIMES CORPORATION
Cincinnati, Ohio
J. & E. WARM CO.
Builders and Contractors
4 Kewanee Type "C" Boilers Installed by
PECK-HANNAFORD & BRIGGS CO.

Modern Factories Need the *EXTRA STEAMABILITY* of

KEWANEE

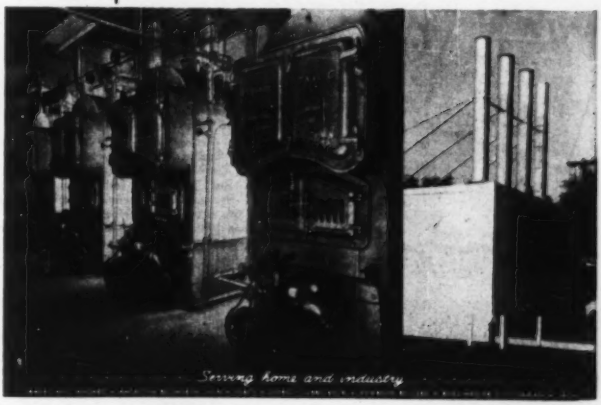
STEEL BOILERS

The design of modern factory buildings is undergoing a radical change . . . spreading out rather than going up . . . with greatly enlarged roof areas, many skylights and the walls largely windows.

While this modern construction provides better light and a smoother flow of materials through production lines it steps up steam requirements.

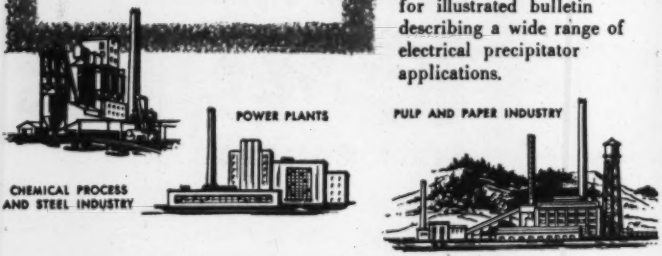
With 4 large Kewanees . . . total capacity of 25,000 square feet steam (5 million Btu) . . . the new plant of Nu-Tone Chimes can be sure of plenty of heat all over the building. And the ability of Kewanee Boilers to carry overloads of 50% and more, with high efficiency, provides an ample reserve to handle later plant expansion without additional boiler equipment.

KEWANEE-ROSS CORPORATION
Division of American Radiator & Standard Sanitary Corporation
KEWANEE, ILLINOIS



Industry looks to
RESEARCH CORPORATION
for high dust collection efficiencies

To maintain visually clean stacks at all times, industry is turning to the long experience of Research Corporation in the design and manufacture of highly efficient Cottrell Electrical Precipitators. We've spent 40 years in solving such problems as nuisance abatement, cleaning gas for subsequent use and recovering materials of value. Write for illustrated bulletin describing a wide range of electrical precipitator applications.



RESEARCH CORPORATION
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122 South Michigan Ave., Chicago 3, Illinois
Bound Brook, N. J.

WISCONSIN-Powered General Electric Welder

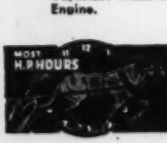
Power to Fit the Job

Keeping snow removal equipment on the job often calls for on-the-spot repairs, handled here by a General Electric trailer-mounted WD-4200 welder. Power is provided by a V-type 4-cylinder Wisconsin Heavy-Duty Air-Cooled Engine.

Engineering know-how and practical design of Wisconsin Engines make their choice a logical one for manufacturers building 3 to 30 horsepower equipment. Only Wisconsin Engines offer a choice of 11 different single-cylinder, 2-cylinder and V-type 4-cylinder models, 3 to 30 hp. Only Wisconsin Engines offer tapered roller bearings at both ends of the crankshaft, taking up all thrusts. In addition, Wisconsin Engines offer an OUTSIDE magneto with impulse coupling for quick starts, steady running. And, of course, foot-proof air-cooling eliminates cooling problems.

* Powered by V-type 4-cylinder Wisconsin Engine.

Write today for complete information about all models.



WISCONSIN MOTOR CORPORATION
World's Largest Builders of Heavy-Duty Air Cooled Engines
MILWAUKEE 46, WISCONSIN

Compressors

Heavy-duty package types of feather valve Compressors from 75 to 350 hp are featured in a new bulletin No. L-676-B1 published by Worthington Corp., Harrison, N. J. The bulletin includes an illustrated discussion of Worthington's feather valve, also frame, running gear parts, cylinder, intercooler, variable capacity control, and such accessories as aftercooler, receiver, and suction filter.

Boilers

A new catalog illustrates and describes the Kewanee square-heat boiler for oil, gas, or stoker firing and includes four new larger sizes. This catalog contains a complete description of quality features, as well as a detailed listing of ratings, dimensions, equipment, and trims.

Copies may be secured by requesting catalog 88 from your nearest Kewanee Branch Office, or directly from the Advertising Dept., Kewanee-Ross Corp., Kewanee, Ill.

Gate Valves

A new 6-page catalog section describing a new line of cast-steel gate valves is available from Edward Valves, Inc., East Chicago, Ind. The booklet contains complete information on details of design, material specifications, pressure and temperature ratings, and dimensional details and weights. Features of gate valves described include close fitting guide ribs which prevent wedge drag on seat faces, one-piece bonnets for accurate stem alignment, and ball bearing yokes for easy operation. A special testing procedure which assures two tight fitting faces is also described.

Chemical Elements Chart

A new periodic chart of the chemical elements, listing some of the latest data about them, has been issued by General Electric Co. Prepared in the G-E Research Laboratory, the chart is printed in green and black on a heavy card, 11 × 14 in. All 98 elements known to date, including berkelium and californium, which were produced at the University of California in 1950, are shown, with their chemical symbols and atomic weights. The latter are taken from the 1952 official list published by the American Chemical Society. Copies of the chart, designated as APH-68B, may be obtained without cost from the General Electric Co., Schenectady 5, N. Y.

Silicone Rubber

The rapidly increasing acceptance of silicone rubber as an important engineering material is shown by the content of Silastic Facts No. 10a, a comprehensive review of the properties and performance of Dow Corning silicone rubber. The new edition provides a detailed discussion of the characteristics of these semiorganic elastomers, devoting separate sections to their resistance to high and low temperatures, to weathering, chemicals and hot oils, to compression set and thermal aging, and to their dielectric properties. A chart summarizes the physical characteristics of 22 leading stocks. Typical applications, including gaskets, seals, mechanical parts, hoses and dielectrics are also described and illustrated. Available from Dow Corning Corp., Midland, Mich.

Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Welding Electrodes

A new, 49-page, pocket-size booklet describing the application, chemical analysis, and mechanical properties of General Electric welding electrodes has been announced as available from G-E Welding Distributors. Designated GED-1634, the booklet also includes an electrode trouble-shooting chart, a chart which specifies the number of electrodes per pound, and an explanation of the significance of the AWS nomenclature.

Radial Air Compressor

Two-stage, air-cooled radial air compressors capable of producing 80 to 125 lb pressure are described in bulletin No. H-630-B1 published by Worthington Corp., Harrison, N. J. The 12-page bulletin gives dimensions and weights of: (1) Bare Compressors, (2) base-mounted multi-V-belt driven compressors (3) base-mounted flexible-coupled compressors, and the (4) Unabloc (close-coupled) compressors. Capacities, sizes, general specifications, and cross-section photographs are included. Pictured and explained are Worthington's articulated connecting rod, fan-cooling of isolated cylinders, forced-feed lubrication and Feather-Valve. Accessories such as air receivers and water-cooled aftercoolers are also pictured and explained.

Cotton and Rayon Mill Electrical Equipment

A new 35-page booklet, No. B-4799, on electrical equipment for cotton and rayon mills is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Emphasizing that substantial savings can accrue from application of modern electrical apparatus, this booklet describes a complete line of electrical equipment for cotton and rayon mills—from switches to bleaching range drives. Lint-free motors, totally enclosed Life-Line ® motors, and Life-line ® gearmotors are among the individual products whose construction, operation, and application characteristics are discussed. Also among the equipment described are packaged-type AV adjustable speed drives, beamer and slasher drives.

MEASURE IN MICROINCHES RMS

"An Essential Unit of Our Production Line"

says BRADFORD PRODUCTION MACHINE COMPANY about the PROFILOMETER

"In our production of cylinders for hydraulic steering units, we consider the Profilometer an essential piece of equipment . . . and the spot for it is right on our production line," says Bradford Production Machine Company of Detroit.

The above illustration shows the three final operations of the production line. The I.D. of the cylinder is bearingized, gaged for dimensional tolerances, and then surface roughness is checked with the Profilometer. Only seconds away from the machining operations, the Profilometer provides the information necessary to assure constant control of the specified surface finish—which, in this case, is from four to six microinches.

In plants throughout the world—wherever control of surface roughness is a requirement—you will find the Profilometer in use as a fast, simple and accurate shop tool. On the job at the time when surfaces are being produced, it can and does make possible many worthwhile savings in production costs.

To learn how the Profilometer can be used to advantage in your plant, write for these free bulletins.

Profilometer is a registered trade name.

MICROMETRICAL MANUFACTURING COMPANY
formerly PHYSICISTS RESEARCH COMPANY
Instrument Manufacturers
ANN ARBOR 6 MICHIGAN

Batch Production Case Hardening

Standard batch furnaces for case-hardening steel are the subject of a new bulletin released by Surface Combustion Corp. Controlled atmosphere equipment, including muffle furnaces and generators plus salt bath pot furnaces and direct-fired oven furnaces, are shown and described with typical applications to gas carburizing, liquid carburizing and cyaniding, and pack carburizing. Write direct to Advertising Dept., Surface Combustion Corp., Toledo 1, Ohio.

Lumber Mill Electrical Equipment

Electrification of all processing operations in the lumber industry is described in a new 50-page book, No. B-5299, available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. Standard and special equipment is described and application data is provided. Freely illustrated with on-the-job photographs, this book takes the reader on a tour of a typical lumber mill—stopping to describe some 21 phases of the application of electric power. Drives for all applications are explained and illustrated, including log-haul, cutoff-saw, hydraulic barker and chipper drives. In addition to the data on drives, the book treats in detail other phases of electrification of lumber mills, such as complete lumber handling systems, automatic control systems, air handling, and mill lighting.

Seamless Mechanical Tubing

A new bulletin, designed to help the tubing user in determining whether he should use hot-finished, cold-drawn, or "roto-rocked" seamless mechanical tubing as the basis for his product, has been issued by the Tubular Products Div. of The Babcock & Wilcox Co., Beaver Falls, Pa. Known as TB-340, the bulletin outlines the differences in methods of production, surface finish, tolerances, and costs of tubing finished by the three processes.

Frame-Type Pumps

Allis-Chalmers frame-type centrifugal pumps designed to handle most ordinary pumping jobs requiring capacities up to 500 gpm and heads as high as 135 ft are described in a new bulletin released by the company. Built for V-belt drive, the frame-type pump can be mounted in a variety of positions and connected to any type of prime mover without difficult alignment problems. Head and capacity can be changed by simply altering sheave size on the V-belt drive. Cross-section diagrams of the three available types of frame-type centrifugal pumps showing the units' rigid cast-iron frame, two single-row ball bearings, mechanical seal, and slinger and seal assembly, together with performance curves, are included. Copies of bulletin No. 52B6691A, are available from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Microwave Components

Titeflex, Inc., 500 Frelinghuysen Ave., Newark, N. J., announces a new 12-page catalog describing its line of microwave components. This booklet includes detailed specifications for both rigid and flexible waveguides plus schematic diagrams and application charts. Titeflex rigid waveguides conform to the MIL-T-85B specification and are specifically recommended for installations where there is no movement of the transmission line or for those portions of a waveguide run requiring the inclusion of complicated accessories.

Cast Tooth Sprocket Wheels

A catalog, No. 2467, of over 200 sizes of cast tooth sprocket wheels available from stock has been published by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. This 8-page book tells how to select stock sprocket wheels for prompt delivery, accurately fitted to the chain. It lists 207 sizes of sprocket wheels carried in stock for 78 popular types and sizes of chains employing cast tooth sprocket wheels. These include Ewart Link-Belt, Class 400 pintle, Class SS bushed roller, Class H pintle, and Class C combination chain. Both arm-center and plate-center wheels, in gray iron or abrasion-resistant Flint-Rim, are available from stock. Flint-Rim wheels are made by a special casting process which increases the hardness of the teeth and helps the wheels to retain their pitch longer.

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...FOR EVERY NEED!

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For lower cost and more efficient spraying try Spraying Systems Spray Nozzles. Complete type and size selection for every need. Write for Catalogs.

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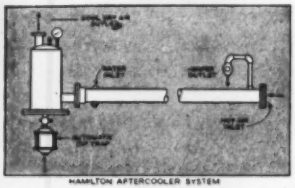
AIR WITHOUT MOISTURE

If you are up in the air about what to buy
Come down to earth where the air is dry.



HAMILTON AFTERCOOLER SYSTEM

MURPHY AFTERCOOLER SYSTEM

The Hamilton Aftercooler System is of the counter current flow design, for the greatest efficiency in cooling compressed air to within a few degrees of the cooling water; the cooled air then enters the regular patented Type A Murphy Automatic Separator where moisture is ejected through the automatic Zip Trap and cool dry air is delivered to the distributing lines.

Write for literature—send us your layout for free engineering assistance with special problems.

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

JAS. A. MURPHY & CO.

Moisture Elimination Up To 3000 Pounds Per Square Inch

Centrifugal Compressors

A well-illustrated, 12-page bulletin, No. 109, on American Blower's line of single-stage centrifugal compressors covers functions, applications, ratings, features of design, arrangements, and methods of control. Available from American Blower Corp., Detroit 32, Mich.

Bearing Lubrication

A folder entitled, "The Lubrication of Fafnir Ball Bearings" discusses the everyday problems of ball-bearing lubrication and maintenance. The basic reasons why lubrication is necessary and a discussion of the advantages of oil or grease are included. In addition, specific illustrations of bearing and housing design are shown. Copies may be obtained from The Fafnir Bearing Co., New Britain, Conn.

Zeolite Water Softeners

Troubles caused by the utilization of hard water and the multiple economies effected by curing them are thoroughly discussed in a comprehensive 16-page bulletin, No. 2386, issued by The Permutit Co., 330 West 42nd St., New York 36, N. Y. The bulletin lists several industries in which steam and water are of importance. It explains the three basic types of ion-exchange equipment and shows how these units can be profitably utilized.

Molded Cups

Complete information on molded cups for pump pistons, hydraulic service, and penumatic equipment is available in a 6-page bulletin issued by the Garlock Packing Co., Palmyra, N. Y. This folder contains illustrations of various types of molded cups, service data, and a complete list of sizes and part numbers. Typical applications are also shown.

Waste Treatment

B-I-F Industries (Builders-Providence, Inc., Proportioneers, Inc., and Omega Machine Co.), Providence, R. I., have announced a new "Industrial Waste Treatment Guide" (Bulletin B-I-F No. 4). This 8-page bulletin contains a highly useful table showing the different types or combinations of unit treatment processes for more than 50 wastes. A second table shows the equipment used in the several unit treatment processes. A third table shows B-I-F Industries equipment available for use in these waste treatment processes. The bulletin contains a two-page spread flow diagram showing how the various treatment processes and equipment may be combined to treat mixed wastes. Installation photos of equipment are also included. B-I-F-4 may be obtained from B-I-F Industries Inc., 345 Harris Ave., Providence, R.I.

Boilers

Catalog No. 92 illustrates and describes the Kewanee round "R" boiler for oil, gas, or stoker firing. This Catalog contains a complete description of the round "R" quality features, as well as a detailed listing of ratings, dimensions, equipment, and trims.

Copies may be secured from your nearest Kewanee Branch Office, or by writing directly to the Advertising Dept., Kewanee, Ill.

Motor Speed Controls

Motor speed controls find many applications in nearly every industry. A new bulletin describes in detail all of the General Radio Variac® motor speed controls. Technical information including speed-torque curves and typical applications are given on all models. Available from General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Direct-Fired Heating Units

The Thermobloc Div. of Prat-Daniel Corp., South Norwalk, Conn., has issued a new catalog, No. NGC-10-52, printed in two colors. It features a full-color cutaway illustration of a Thermobloc direct-fired heating unit. Various models manufactured by the company are illustrated, both photographically and with line drawings. Specifications and dimensions on all models are listed.

BLAW-KNOX STEEL GRATING
in the Front Rank of Industry
ON ALL 5 COUNTS

OPEN SPACE • STRENGTH
LONG LIFE • CLEANNESS
SAFETY

Blaw-Knox Steel Grating is electroforged into rigid, one-piece panels, using twisted cross bars for firm footing. Bring your open steel flooring problems to Blaw-Knox for expert help. Bulletin 2365 sent on request.

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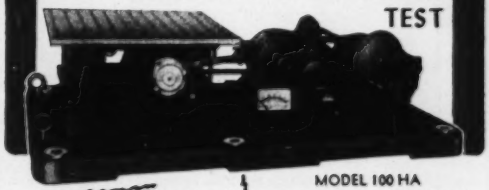
BLAW-KNOX Electroforged STEEL GRATING

Give Parts, Assemblies a Positive
VIBRATION TEST



ALL AMERICAN VIBRATION FATIGUE TESTING MACHINE

MODEL 100 HA
Capacity 100 Lbs. Produces Vibrations horizontally. All controls in easy reach.

NATIONAL Bureau of Standards uses four, Mass. Inst. of Technology two, Western Electric 13, Westinghouse and G. E. 12 each. Basic Equipment for YOUR testing laboratory or inspection department. In many plants a laboratory in itself. Detect excess weight—find structural weak spots.

For electronic, automatic aircraft, crystal, optical and instrument makers, schools and research laboratories. Models to test parts from a few ounces to 100 lbs. Choice of horizontal or vertical table movement. Frequencies of 600 to 3600 v. p. m. Automatically or manually controlled. Send for Catalog F.

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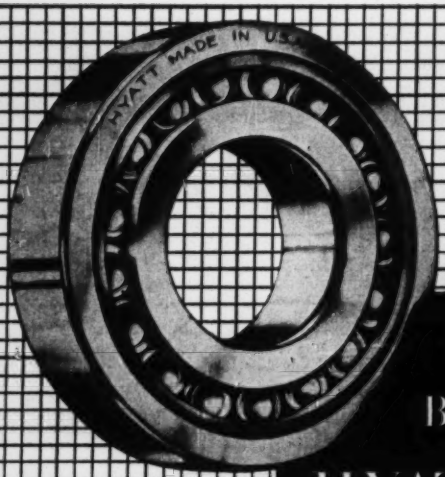
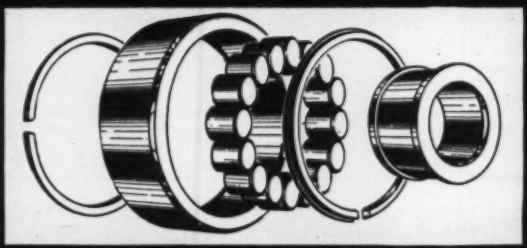


For Maximum
Bearing Capacity

HYATT HY-LOADS



THERE are ten major types of Hyatt Hy-Loads—the high capacity cylindrical roller bearings for radial or light or intermittent thrust loads.

Four of the ten Hy-Loads have separable inner races, two have separable outer races and four are non-separable. Made in two diameter series, wide and narrow widths, to standard boundary dimensions, they permit wide flexibility in machine design and assembly procedures.

Typical of the Hyatt-Hy-Load line, the U-TM bearing, one of the non-separable types is illustrated and shows its full complement of rollers for maximum bearing load-carrying capacity.

And all other types, too, are just as correct in their design and equally precision-built for the kind of dependable bearing performance you expect from Hyatt equipped machines. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

NO LUDLOW FIRE HYDRANT HAS EVER FAILED IN LINE OF DUTY!

Everdur stems resist stresses, strains and corrosive attack

Everdur* has helped to endow many types of products with the same time-tested reliability of performance of which the makers of these Ludlow Fire Hydrants are so justifiably proud.

Everdur,* The American Brass Company's group of Copper-Silicon Alloys, has long demonstrated its ability to resist corrosion while at the same time providing strength, toughness and unusual fatigue resistance plus easy workability and weldability. It provides many of the properties required for tin-bronze application.

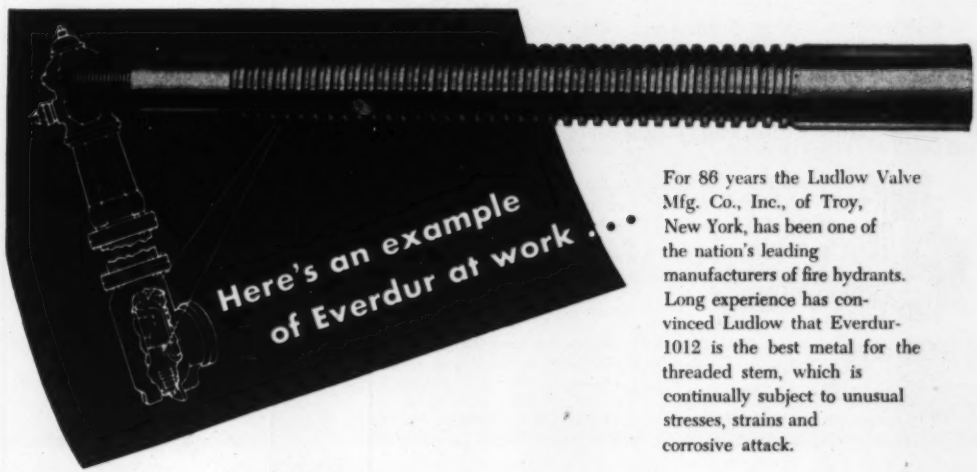
Tell us what you make – and how it is to be used. We'll do our best to help you get the right metal. It may be Everdur or one of a dozen different ANACONDA Alloys. Address The American Brass Company, General Offices, Waterbury 20, Connecticut.

*Reg. U. S. Pat. Off. 5280

EVERDUR is produced in nearly all commercial forms including casting ingots for remelting. It offers:

High Strength and Toughness
Unusual Fatigue Resistance
Excellent Corrosion Resistance
Weldability plus *Workability*
Machinability

Publication E-5 gives Applications, Physical Properties and Constants of Everdur. Publication E-1, on Everdur Casting Ingots, describes Foundry Practice and Procedure. Write for either or both.



The Everdur-1012 (free-cutting alloy) stem, used in the Ludlow Hydrant, is 15" long with a 1-5/16" –4 square–cut thread.

For 86 years the Ludlow Valve Mfg. Co., Inc., of Troy, New York, has been one of the nation's leading manufacturers of fire hydrants. Long experience has convinced Ludlow that Everdur-1012 is the best metal for the threaded stem, which is continually subject to unusual stresses, strains and corrosive attack.

EVERDUR

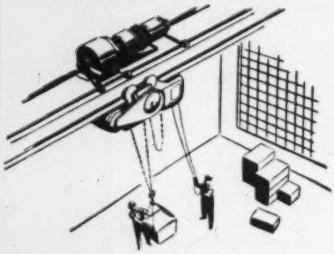
ANACONDA®

COPPER-SILICON ALLOYS

STRONG • WELDABLE • WORKABLE • CORROSION-RESISTANT

American Blower . . . a time-honored name in air handling

San Francisco has a conveniently located American Blower office to provide you with data and equipment for air handling. You can reach American Blower in San Francisco by calling Sutter 1-1024. In other cities, consult your phone book.



SMOOTH POWER

If you're concerned with power transmission you'll want to know more about our Gyrol Fluid Drives. They offer three important advantages—smoother acceleration, overload protection and substantial power savings. One company uses Fluid Drive on a crane that picks up ladles of hot metal. Before they were installed, the ladles got a violent swing from the quick start and were hard to control. Since using Fluid Drives they've had no trouble.

R_ FOR AIR

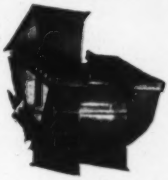
One of the stiffest tests air handling equipment can get is that imposed by hospital laboratories. Cultures and tests require a sterile atmosphere. Temperature and humidity must often be closely-controlled. Recently, a large university hospital selected American Blower ventilating equipment for its new laboratory . . . a fine tribute not only to the quality of American Blower products, but also to the effectiveness of our research and testing methods. Why not put this valuable experience to work for you?

BETTER BURNING

American Blower Mechanical Draft Fans play an essential part in the efficient operation of several new municipal waste disposal works. The high static efficiency, low RPM, low tip speed and rugged construction of these dependable fans help provide and maintain proper combustion without high power costs. In military or civilian installations American Blower equipment meets the most exacting requirements. If you are expanding or enlarging your facilities, consult us.

If your needs call for heating, cooling, drying, air conditioning or air handling equipment you'll find American Blower an excellent source of supply. For data phone or write our nearest branch office.

Unit Heaters



Mechanical Draft Fans

Dust Collectors

Centrifugal Compressors

Industrial Fans

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
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Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

YOUR BEST BUY AMERICAN BLOWER AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

SAFE SURE FAST EASY

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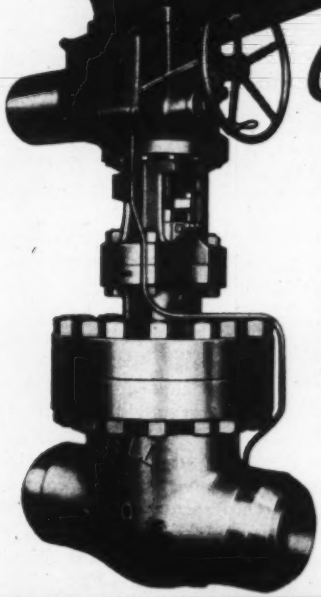

Get all 4 with LIMITORQUE

For remote or local control ... positive, speedy, safe, dependable opening and closing of all types of valves up to 120" diameter ... equip with Limitorque. *Just pushing a button sets them in operation.*

They provide complete safety in two ways: First, they protect the workmen by eliminating the need of climbing to high or hazardous locations for manual valve operation. Second, they protect the valve operating parts by assuring a tight valve closure without overload on disc, seating rings or valve stems ... and by automatically shutting-off the motor if foreign obstructions are met during the closing cycle.

Limitorque is actuated by any available power source ... electricity, air, water, gas or oil.

Your valve maker can supply Limitorque Controls.

For complete details about Limitorque, send for Catalog L-50.

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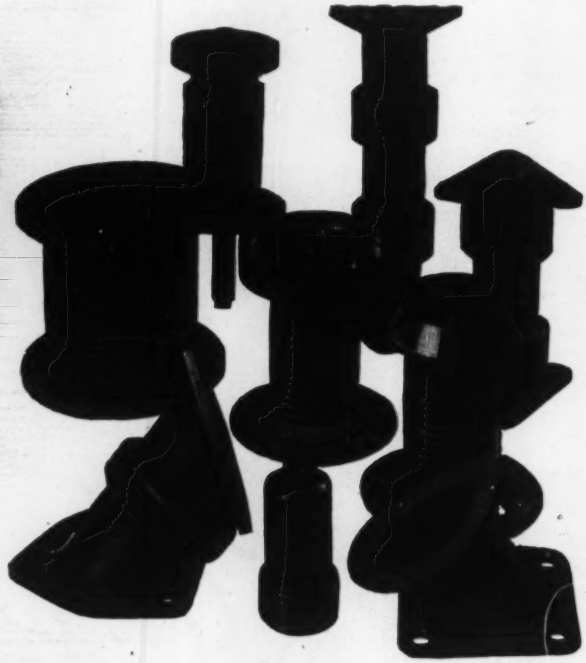
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

MECHANICAL MAGICIANS *made-to-order!*



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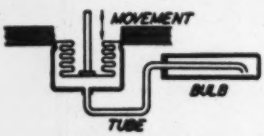
Packless construction to absorb thermal expansion of pipe lines.

Bellows Assemblies for every need...in many metals



THERMOSTATIC MOTOR

Thermostatic charge confined outside bellows and within cup. Bulb optional.

Whatever your bellows assemblies requirements—current or projected—you'll find at Fulton Sylphon and Bridgeport Thermostat the abilities and facilities to fulfill your needs. Exactly, efficiently and economically.

For you get here the help of specialists in this field, backed by half-a-century of experience. You get expert assistance in designing and developing bellows assemblies specifically adapted to your products. You make cost-savings, too, because you can turn over to us the complete production job. No time-wasting worries for you.

Consult with us on any application where bellows assemblies can be used. For example—opening and closing valves, dampers, etc.... for providing packless construction ... for absorbing expansion ... wherever there's a design problem involving control of temperature or pressure. Wide range of metals and sizes. Write for booklet filled with ideas—ask for Catalog XK-1200.

TEMPERATURE CONTROLS

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DIVISION
Knoxville 4, Tenn.

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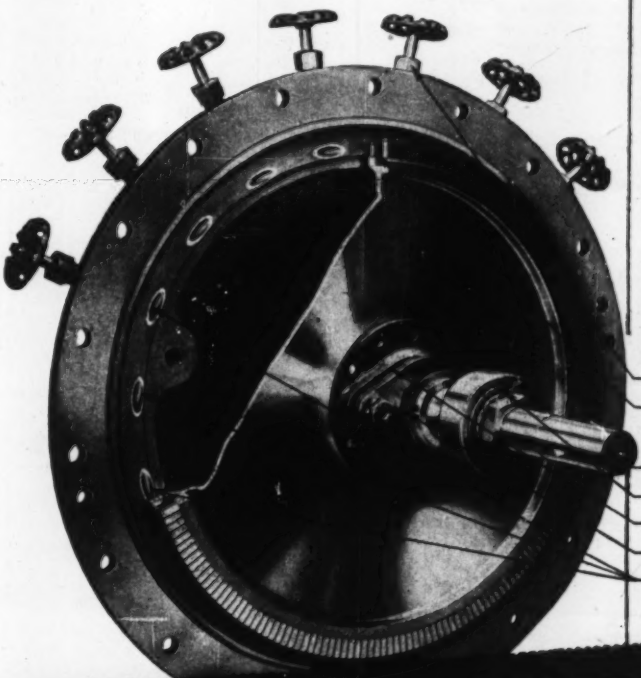
BELLOWS ASSEMBLIES • BELLOWS DEVICES

BRIDGEPORT THERMOSTAT
DIVISION
Bridgeport 1, Conn.

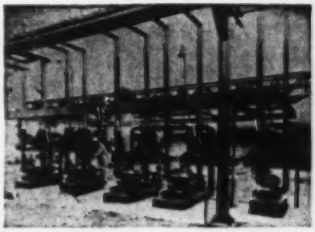
No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
- Oversized double row deep grooved ball bearing
- Stuffing box with metallic packing ring
- Heavy chrome plating of shaft through stuffing box
- 3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

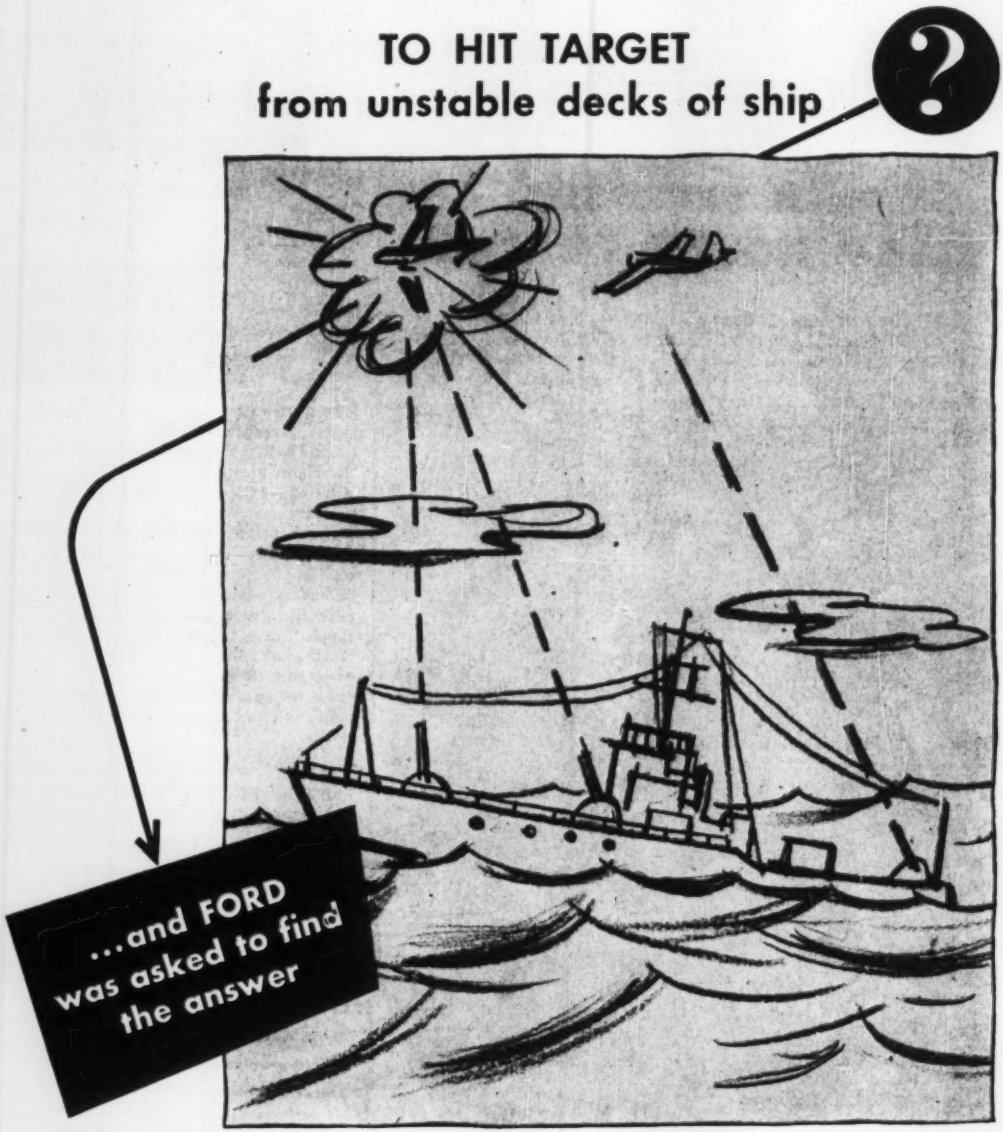
Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP.,
372 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

TO HIT TARGET from unstable decks of ship



A rolling, pitching ship... under attack from speedy, diving aircraft... counts on its anti-aircraft guns for protection... these guns must be able to stay on the target regardless of sea conditions. That's why the Ford Instrument Company was called on to design and build a control system that tracks and holds the target range with deadly accuracy.

This is typical of the problems that Ford has solved since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

4

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for illustrated brochure.

FORD

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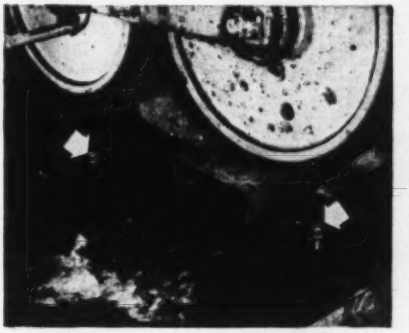
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

12 months "Snorkel" duty... and still in excellent condition



↑ Relubrication fittings for Fafnir Pillow Blocks are indicated by arrows. Once-a-week lubrication plus Fafnir Mechani-Seals protect submerged bearings.

↓ Complete installation shows relubrication fitting, pipe and Fafnir Pillow Block.

Standard Fafnir Ball Bearing Pillow Blocks

On a conveyor used for lifting steel balls from the water quench bath of a rotary type furnace are two 1½" Fafnir LAK Type Ball Bearing Pillow Blocks. These bearing units, running at 2-3 r.p.m., are three feet under water. The water bath has a pH of about 6 and a temperature automatically controlled at 90°F.

After 12 months of operation at 16 hours a day, 6 days a week, the pillow blocks were removed for inspection. Their condition is shown in the unretouched photograph below. According to a maintenance report, both the pillow blocks and bearings were in excellent condition and suitable for further service.

This application may help you to find a better, cheaper way to use bearings. Although it's unusual . . . it serves to demonstrate the multiple-uses of Standard Fafnir Ball Bearing Units plus their ability to operate efficiently under extreme conditions. Whatever your bearing problem, a few minutes spent with a Fafnir representative may help you solve it as successfully. The Fafnir Bearing Company, New Britain, Conn.

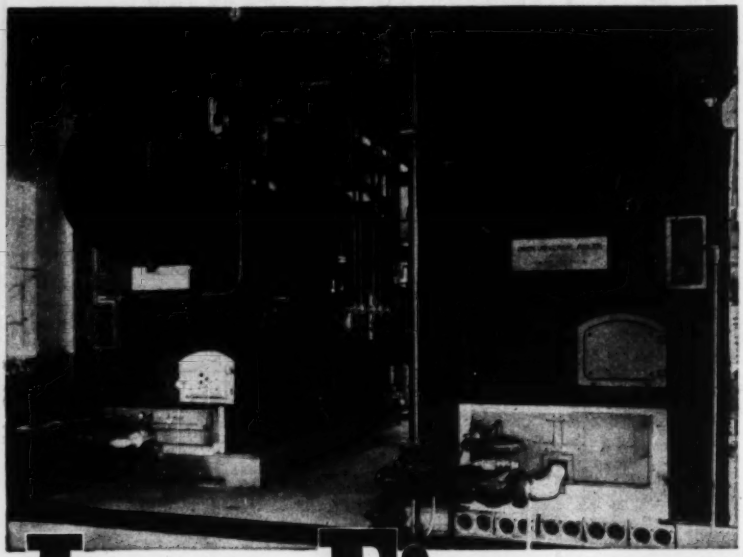
FAFNIR

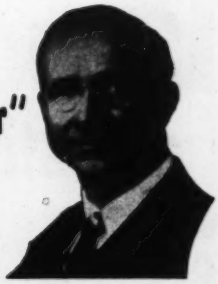
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

Unretouched photograph of Fafnir Pillow Blocks, one disassembled, shows condition after 12 months operation 3 feet under water.

"Our Iron Fireman Gas Burners maintain a more even steam pressure and save manpower"





says Mr. O. Carlyle Brock
President, Sanida Sanitary Farms Dairy, Inc.
Erie, Pennsylvania

"Our original boilers were coal fired, and since changing to your gas burners, we can maintain a more even steam pressure and are experiencing considerable savings in manpower. Our load changes quite rapidly and at no time have we been held up for lack of steam. We are also able to maintain a clean boiler room which is quite important in dairy operations."

Both boilers at Sanida Dairy (100 h.p. and 150 h.p.) are fired by Iron Fireman GCR vertical-type Gas Burners. Zone fire control permits low-fire start and self-adjusting modulated firing. Automatic damper controls enable rapid heat response.

Iron Fireman Gas Firing for heating, power, or processing

Iron Fireman gas firing is saving users many fuel dollars. "Control" is the answer—control of the fuel-air ratio for the most efficient combustion; *control* of the firing rate to instantly adjust to the load; and *control* to compensate for varying pressures in the gas supply. No other gas firing gives such outstanding performance and savings. They are available in three styles—inshot burners, vertical-type burners, and ring-type burners, for boilers up to 1,000 horsepower. Find out how much an Iron Fireman can save for YOU. Phone your nearest dealer or send the coupon below for descriptive literature.

Horizontal Rotary Oil Burner

Fires low-cost, heat-rich heavy oils (Nos. 5 and 6) with complete steadiness and dependability. Oil feed rate is constant, even with changes in viscosity of oil.

Coal-Flow Stoker

Feeds coal direct from bin. No coal handling. Synchronized coal and air supply automatically adjusted to boiler load at all times. Capacities to 400 boiler h.p. Pneumatic Spreader models also available.

MAIL COUPON FOR FULL INFORMATION

IRON FIREMAN MFG. CO., 3269 W. 106th Street, Cleveland 11, Ohio

Please send literature as checked:

- ☐ Commercial Gas Burners
- ☐ Coal-Flow Stokers
- ☐ Rotary Oil Burners
- ☐ Pneumatic Spreader Stokers

Name_____

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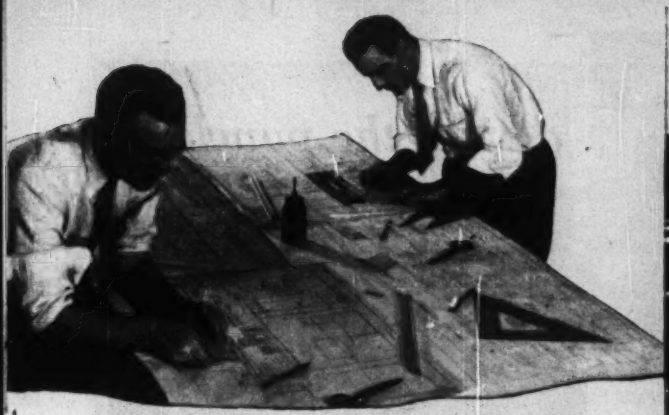
City_____ State_____

AUTOMATIC FIRING FOR HOMES, BUILDINGS, INDUSTRIAL PLANTS



The American Brass Company, Waterbury, Conn., reports

Plant layout speeded

with Kodagraph Autopositive Paper

THE engineering and drawing reproduction departments of The American Brass Company must keep pace with the constant plant-layout demands of ten manufacturing divisions. *And here's how Autopositive Paper saves time and dollars in this work.*

First, paper cutouts of machines and equipment are pasted in position on a whiteprint of the proposed layout. From this opaque pasteup, a positive reproduction on Autopositive Paper is made *directly*. There's no negative step, no darkroom handling with this revolutionary photographic intermediate material. Just exposure in a standard whiteprint machine . . . processing in standard photographic solutions.

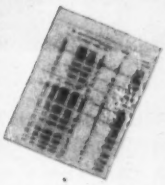
Then, the Autopositive intermediate—with dense photographic black lines on a durable, evenly translucent base—is used to produce the desired number of prints. These are sent to the branch involved to be studied and returned with comments.

This procedure may be repeated half a dozen times until complete agreement is reached on the final layout. And *every time* revolutionary Autopositive Paper saves time and dollars!

Other important uses of Kodagraph Autopositive Paper at American Brass

. . . to reproduce the blueprints and direct-process prints which the various divisions receive from vendors. The Autopositive intermediates are then used to produce any number of shop prints.

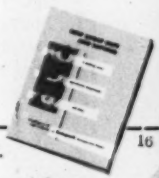
. . . to reclaim old, soiled, or worn drawings. Autopositive Paper intensifies line details . . . drops out smudges, creases—delivers intermediates which produce clean whiteprints and blueprints.



. . . to speed print service to all departments. Autopositive reproduces production reports, parts lists, documents of every type. And opaque originals can be copied as readily as translucent ones.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction



Learn how Kodagraph Autopositive Paper is simplifying routines in thousands of concerns. Write today for a free copy of "New Short Cuts and Savings" for interesting facts about companies you know . . . and a revolutionary new product *you should know.*

MAIL COUPON FOR FREE BOOKLET

EASTMAN KODAK COMPANY, Industrial Photographic Division, Rochester 4, N. Y.

Gentlemen: Please send me a free copy of your new illustrated booklet, "New Short Cuts and Savings."

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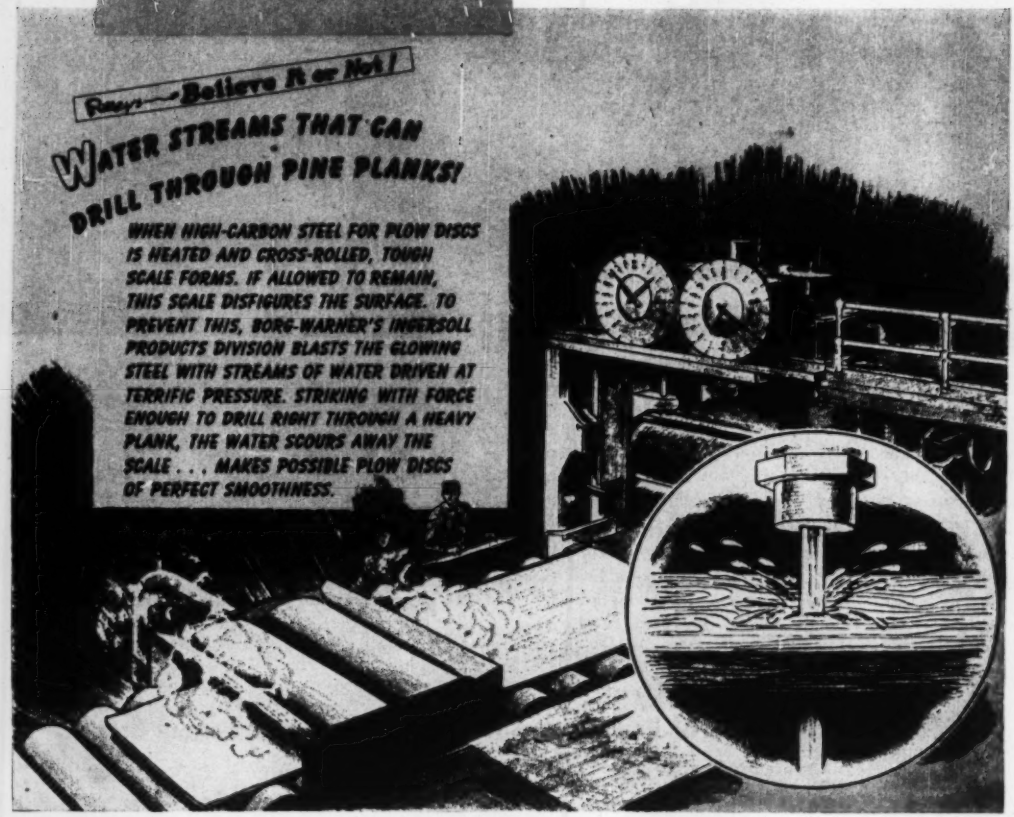
16

Kodak
TRADE-MARK

DE LAVAL
DESCALING SPRAY PUMPS

deliver the punch


Boys!—Believe It or Not!
WATER STREAMS THAT CAN DRILL THROUGH PINE PLANKS!
WHEN HIGH-CARBON STEEL FOR PLOW DISCS IS HEATED AND CROSS-ROLLED, TOUGH SCALE FORMS. IF ALLOWED TO REMAIN, THIS SCALE DISFIGURES THE SURFACE. TO PREVENT THIS, BORG-WARNER'S INGERSOLL PRODUCTS DIVISION BLASTS THE GLOWING STEEL WITH STREAMS OF WATER DRIVEN AT TERRIFIC PRESSURE. STRIKING WITH FORCE ENOUGH TO DRILL RIGHT THROUGH A HEAVY PLANK, THE WATER SCOURS AWAY THE SCALE . . . MAKES POSSIBLE PLOW DISCS OF PERFECT SMOOTHNESS.

The pump that delivers the punch is one of the new De Laval Oppeller pumps.

De Laval builds a complete line of multistage opposed impeller pumps for this service. Sizes range from two to eight stages for pressures to 1,200 psi, capacities to 1,000 gpm and temperatures to 350F. Impellers are mounted to provide leak-proof shaft sealing between stages. The shaft is exposed to insure freedom from distortion. Stuffing boxes are removable. Positive interstage wearing rings eliminate leakage.

For a host of steel plant jobs, it pays to decide on *quality-designed* De Laval equipment. Look into the advantages of De Laval blast furnace blowers, coke oven boosters and exhausters, general service and process pumps, mechanical drive turbines and worm gear speed reducers. Consult your De Laval Field Engineer.

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY
806 Nottingham Way, Trenton 2, New Jersey

DL 180

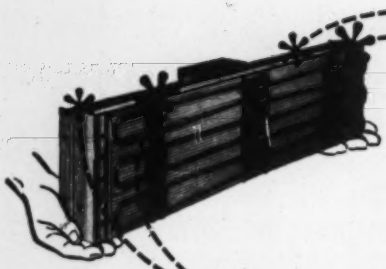
AMERICAN FELT REALLY SEALS!

Shown above is an OilFoil seal, consisting of two layers of felt, bonded with two septums of Hycar, the synthetic rubber-like substance that is impervious to and unaffected by oils, greases, and the hydrocarbons used in hydraulic systems. Such washers can have one, two, or three septums, to keep lubricants in and seal out water, dirt, gases and retain pressures. If there is no lubricant in the enclosure, the felt can be impregnated with oil or grease, to provide lifetime bearing lubrication. OilFoil seals are supplied cut to exact dimensions, ready for assembly, and usually require no attention between major overhauls. For more information, write for Data Sheet No. 11, "Felt Seals, Their Design and Application." Free. American Felt's Engineering & Research Department will gladly collaborate with you on sealing and lubrication problems, and on any other matters concerned with felt.

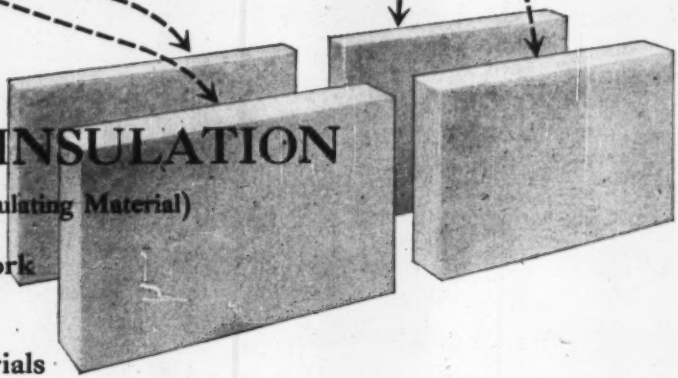
American Felt Company
TRADE MARK

GENERAL OFFICES: 50 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.



In CHROMALOX Electric Radiant Oven Panels . . .



Johns-Manville MARINITE INSULATION

(A Structural Insulating Material)

—puts more heat to work
—lasts longer
—saves time and materials

TWO KINDS of outstanding engineering experience combined to develop the new Chromalox Electric Radiant Panels for industrial ovens:

1. **Chromalox engineering experience** gained in more than 3,000 far-infrared drying, baking and curing installations.
2. **Johns-Manville insulation** engineering experience gained in solving industry's most complex insulating problems for nearly a century.

To assure highest operating efficiency in these compact "packaged" far-infrared oven sections, manufactured by Edwin L. Wiegand Company of Pittsburgh, J-M insulation engineers recommended Marinite*. This rigid thermal insulation is used in place of insulation sandwiched between two metal faces.

Marinite is an asbestos insulating material that combines great structural strength and excellent thermal characteristics. It was recommended for Chromalox Electric Radiant Oven Panels for 3 important reasons: (1) Marinite minimizes heat loss, saves electricity, (2) Marinite makes thermal insulation a built-in component that also provides electrical insulation and mechanical strength, (3) Marinite saves both time and materials during manufacture because it is easy to work and is used alone without facings.

• • •

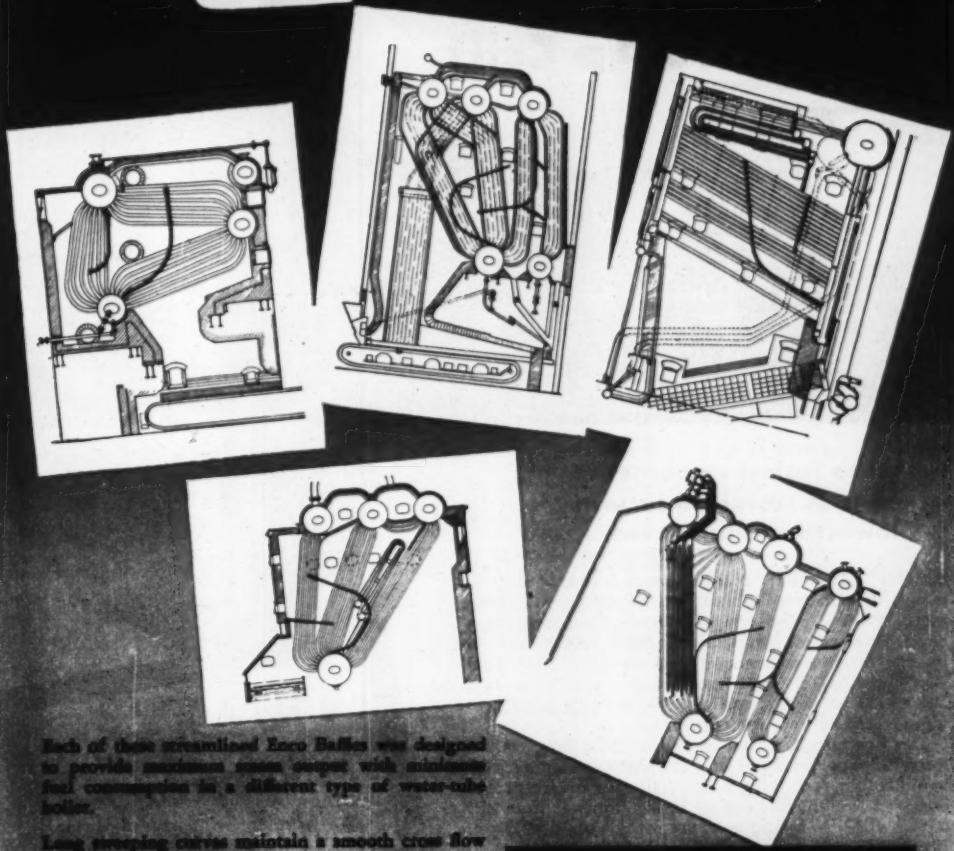
If you would like further information about Marinite structural insulation and its application to your product or plant equipment, write Johns-Manville, Box 60, New York 16, N.Y. In Canada: 199 Bay Street, Toronto 1, Ontario. *Reg. U. S. Pat. Pat. Off.

Johns-Manville FIRST IN INSULATION

MATERIALS • ENGINEERING • APPLICATION

Streamlined for Savings

IN EVERY TYPE OF BOILER



Each of these streamlined Enco Baffles was designed to provide maximum steam output with minimum fuel consumption in a different type of water-tube boiler.

Long sweeping curves maintain a smooth cross flow of gases across every square foot of heating surface. Eddy currents, bottlenecks and dead gas pockets are eliminated—draft losses are cut to a minimum. Soot blowers work more effectively, less steam and less time are needed for cleaning.

Enco Streamline Baffles are individually designed and engineered to the exact requirements of your boiler. Experienced Enco-trained crews take charge of the installation.

The 16-page Enco Bulletin, BW44, shows how engineers throughout industry have gotten higher boiler efficiency and increased steam production through the use of Enco Streamline Baffles. Why not write for your FREE copy today?

The Engineer Company Produces:

ENCO OIL BURNERS

ENCO FUEL OIL PUMPING AND HEATING UNITS

ENCO AUTOMATIC OIL-ELECTRIC IGNITION SYSTEM

ENCO AUTOMATIC COMBUSTION CONTROL

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

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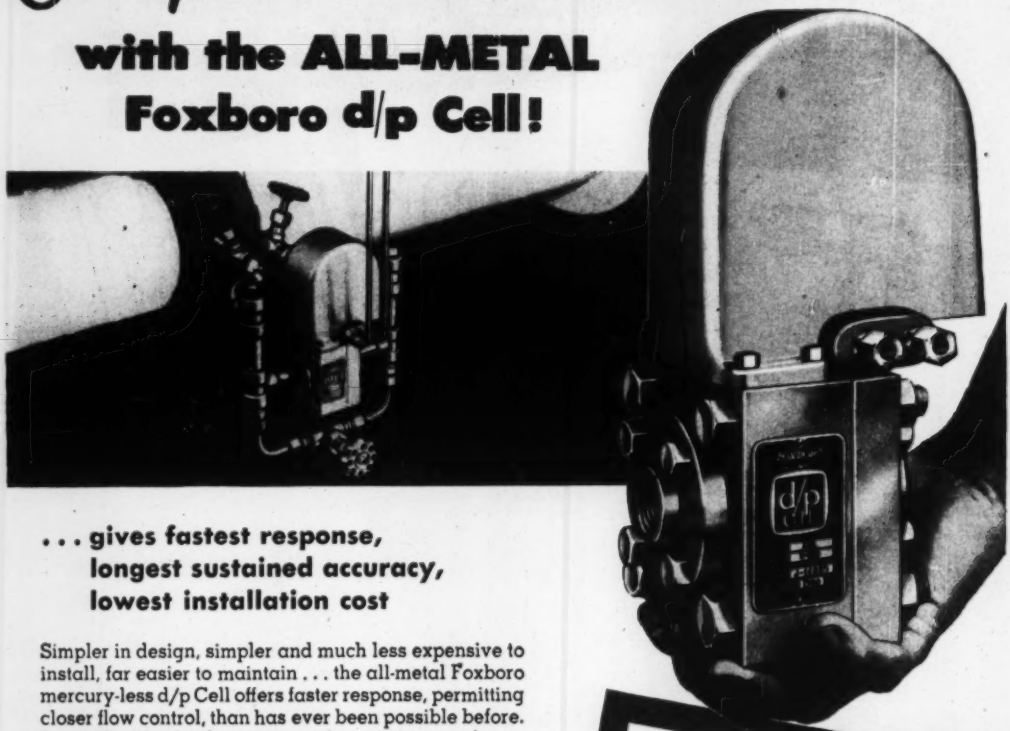
Simplest Flow Measurement

with the ALL-METAL Foxboro d/p Cell!



. . . gives fastest response, longest sustained accuracy, lowest installation cost

Simpler in design, simpler and much less expensive to install, far easier to maintain . . . the all-metal Foxboro mercury-less d/p Cell offers faster response, permitting closer flow control, than has ever been possible before. Its negligible displacement and corrosion-proof construction eliminate usual maintenance problems, even in service on highly corrosive or viscous fluids previously considered unmeasurable.

The Foxboro d/p Cell measures fluid flow by the force-balance principle and transmits pneumatically to indicating, recording, or controlling receivers. Small, compact, weighs as little as 19 lb. Ranges: from 25" to 800" H_2O. Working pressure ratings up to 4000 psi. Steel or Type 316 Stainless Steel construction.

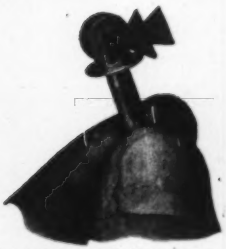
Thousands of d/p Cells now in use throughout industry, with many repeat orders now on our books, indicate the wide acceptance and successful performance of this revolutionary development for the measurement of liquid, steam, gas, or air flow. Write for detailed Bulletin 420. **The Foxboro Company, 9612 Neponset Avenue, Foxboro, Massachusetts, U. S. A.**

- No seal pots
- No mercury
- No leveling
- Installed at the orifice

FOXBORO
REG. U.S. PAT. OFF.

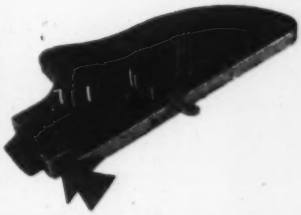
RECORDING · CONTROLLING · INDICATING
INSTRUMENTS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

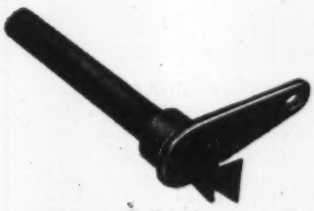


AS A SHAFT . . . Rollpin serves as an axle for the sparkwheel of a cigarette lighter. No riveting or threading necessary . . . faster assembly. Note flush, clean fit.

AS A DOWEL . . . Rollpin is used here to prevent rotation of a thrust bearing. No reaming, no special locking. Easily removed. Lowest possible dowel pin cost.



AS A CLEVIS PIN . . . here Rollpin holds firmly in clevis, permits free action of moving member. Rollpin application above is with the plate of a home workshop tool.



AS A KEY . . . Rollpin demonstrates its ability to do away with precision tolerances, in this heating system damper arm. Faster, cheaper and more satisfactory than usual assemblies.

AS A STOP PIN . . . in this application. Rollpin is shown in a ratchet wrench adaptor. With its light weight and high shear strength, Rollpin functions perfectly . . . cuts assembly costs.

AS A SIMPLE FASTENER . . . Rollpin replaces a set screw in pinning a gear to a shaft. Assembly time is shorter, service life longer. Vibration-proof flush fit. Easily removable.

YOUR IMPORTANT FASTENING JOBS

are cheaper . . . faster, with ROLLPIN TRADE MARK

Rollpin is a pressed-fit pin with chamfered ends. It drives easily into holes drilled to normal tolerances, compressing as driven. No reaming, no tapering, no extra assembly steps required. Rollpin fits flush, *locked* in place by the constant pressure it exerts against the hole walls. Can be inserted with automatic press, or by hand—removable with a drift or pin punch.

Rollpin is reusable again and again.

Elastic Stop Nuts with the famous red collar are another ESNA product

ESNA

MAIL COUPON TODAY. If your present operations or plans include the above applications—or set screws, rivets, hinge pins, cotter pins, pivot pins, taper pins—you can't afford to be without complete details on Rollpin. Write now—find out how much faster and cheaper Rollpin can do the job.

Section R1-1211, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free information on ESNA self-locking fasteners:

☐ Rollpin bulletin and sample Rollpins ☐ AN-ESNA conversion chart
☐ Elastic Stop Nut Bulletin ☐ Here is a drawing of our product. What fastener do you recommend?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____

Visit Booth No. 6

NATIONAL POWER EXPOSITION

New York City • DECEMBER 1 to 5

You are cordially invited to visit Booth No. 6 to inspect the Republic Electronic TELEMASTER Control which will be on exhibit. Our engineers will be available to explain its many unusual features. The complete line of Republic instruments and controls will also be included in the exhibit.

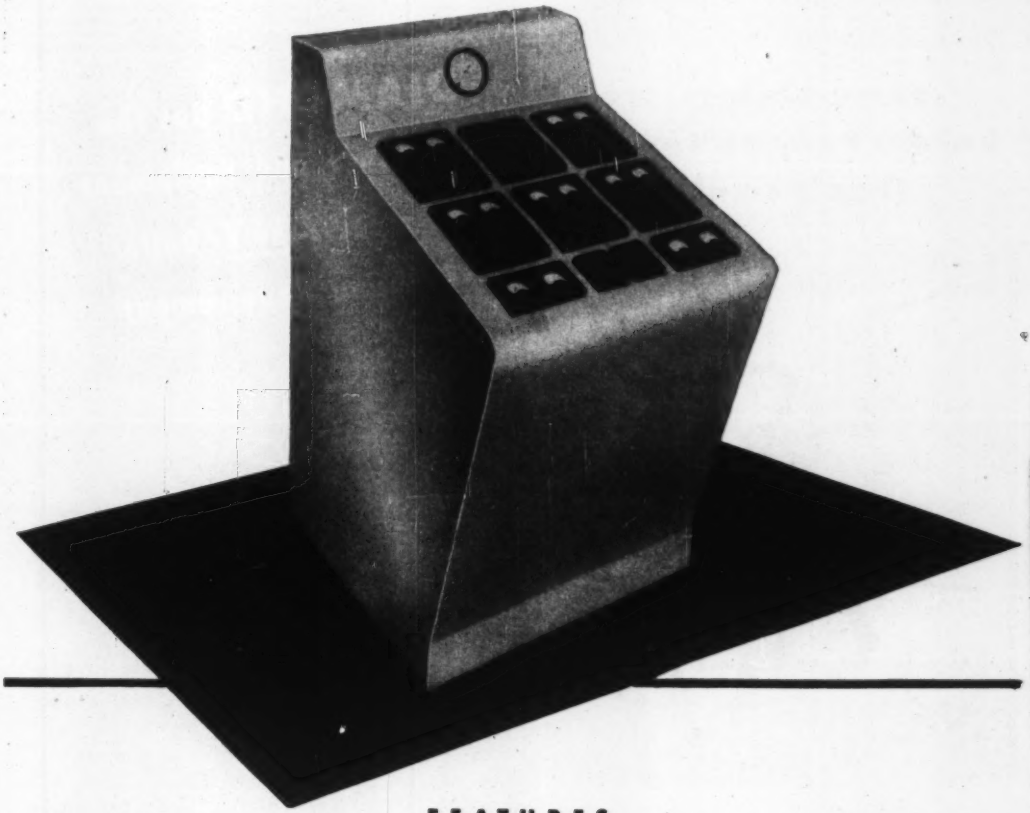
REPUBLIC

Electronic Master Control System

"TELEMASTER"

The Republic Electronic TELEMASTER Control represents a major advance in the field of automatic control. The TELEMASTER will remotely reproduce, quickly and accurately, a position or a force—perform arithmetical and algebraic calculations—and can be used for multiple operation. Essentially it performs the functions of a mechanical link through electrical and electronic means. It is applicable to all types of combustion and process control.

In plants where distances between operating units are great, the lags inherent in the compression effect of a pneumatic master system are appreciable. This effect is frequently sufficient to prevent realization of the full benefits of automatic control. The Republic Electronic TELEMASTER Control has a minimum inherent lag, independent of distance. This means that centralization of operations can be achieved without any sacrifice of control performance. *Full details sent upon request.*



FEATURES

NO DEAD SPOTS OR LAGS

The TELEMASTER operates on a null-balance principle with a constant check-back between the initial input and final output, with no intervening mechanisms to cause dead spots or lags. This balance type detection of any deviation in the desired operating conditions, produces a highly responsive and fast acting control system.

ELIMINATES PANEL PIPING

No control panel piping is necessary with the REPUBLIC TELEMASTER. Easily installed, multi-wire cables are the only connection between the TELEMASTER benchboard and the plant measuring and control elements. Results? Easier, faster and better appearing installation, increased flexibility, economy, and reduced maintenance.

GREATER APPLICATION FLEXIBILITY

Flexibility required for complete centralization of controls at a central focal point is a distinct feature of the TELEMASTER. The system may be operated under completely automatic, semi-automatic, or manual control from a central supervisory station.

PLUG-IN INTERCHANGEABLE PARTS

Due to simplicity, compactness and interchangeable component parts, the TELEMASTER provides a more flexible control system and a more condensed panel area than previously possible. All parts subject to replacement are mounted on compact plug-in units that are easily interchanged and replaced with spare parts.

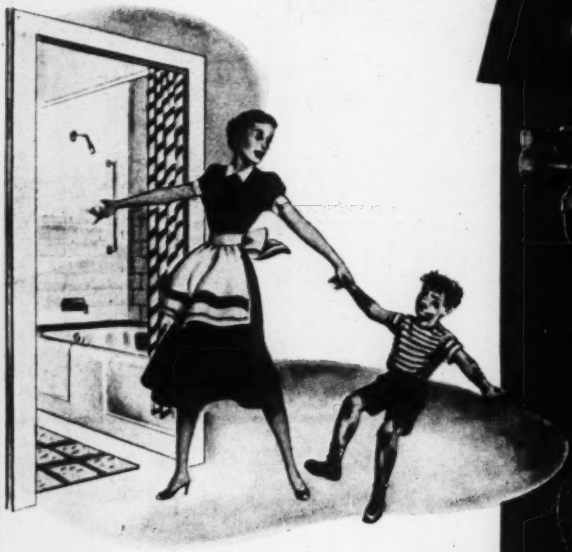
REDUCED MAINTENANCE

Control room maintenance is sharply reduced. No moving parts or mechanisms are mounted on the control panels. Panel equipment is smaller and less cumbersome, no panel piping is used. Plug-in replacement parts may be installed in a matter of seconds. All components of the TELEMASTER are fully tested and proven for prolonged trouble free service.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

some boilers are harder to keep clean than a small boy....



At certain ages a small boy defies all efforts to keep him clean. He has a magnetic attraction for dirt. You can scour him, dress him and threaten him, and in five minutes he looks like something out of a hobo jungle.

Some boilers are like that. Often burning inferior fuels, they are continually bathed in an atmosphere of soot and slag-forming products of combustion. Engineers nurture ulcers trying to keep such boilers clean and in good operating condition. Necessary complexities of modern high service designs do nothing to ease the job.

For boilers that are hard to keep clean, call upon Diamond Blowers. During our 49 years in the soot blower business, we have tackled and licked the toughest cleaning jobs. You can always depend upon Diamond for correct boiler cleaning at the lowest overall cost.

DIAMOND Has the Experience and Equipment to meet ANY Boiler Cleaning Requirement

Diamond Model IR
Short Retracting Blower.

Diamond Panel for automatic control of complete cleaning cycle.

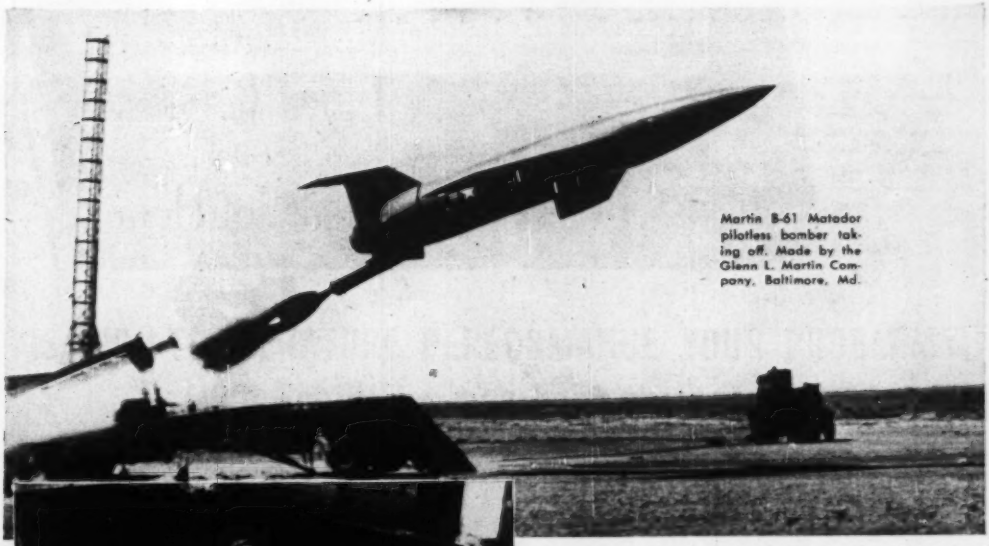
Diamond Model GSE
Automatic Valved Blower.

Diamond Model A2E
Automatic Air Puff Blower.

Diamond Model IK
Long Retracting Blower.

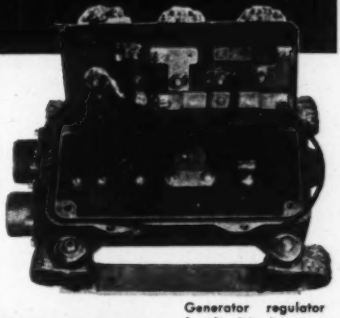
4828

DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO • *Diamond Specialty Limited, Windsor, Ontario*

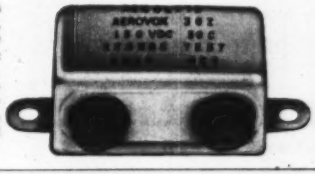


Martin B-61 Matador pilotless bomber taking off. Made by the Glenn L. Martin Company, Baltimore, Md.

Jeep almost completely submerged. Can be operated in this position at about 9 miles per hour. Made by Willys-Overland Motors, Inc., Toledo, Ohio, for the Armed Forces.



Generator regulator for the 24-volt system of the submersible Jeep. This is completely waterproof and highly resistant to corrosion and fungi. Produced by The Electric Auto-Lite Company, Toledo, Ohio.



Illustrated are two of the many types of capacitors and filters made by Aerovox Corporation, New Bedford, Mass.; an important capacitor supplier to both Electric Auto-Lite and Glenn L. Martin. The unit above is the filter capacitor used in the generator regulator of the submersible jeep while the unit at the right is used in the pilotless bomber.

In the Air— On Land— Under Water—

WHERE REQUIREMENTS ARE SEVERE, CALL REVERE

The dramatic pictures on this page show two important special applications of Aerovox capacitors. One is the Martin B-61 Matador pilotless bomber. It contains an Aerovox capacitor, which has to withstand the terrific acceleration and speed of the craft. The other is the submersible Jeep. Its 24-volt electrical system is completely waterproofed, and includes Aerovox filters and capacitors for suppression of radio interference. Revere not only supplied copper and brass strip for the capacitor cases, but collaborated closely in setting up specifications, and in addition worked on a welding problem. In regard to the latter, an Aerovox Project Engineer wrote: "We have had much better welds." . . . Revere is always glad to collaborate on problems concerning copper and its alloys, aluminum alloys, and electric welded steel tube. Call the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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THE RED KOREAN strongpoint had stalled our attack; Lieutenant Burke saw that a breakthrough must be made. Rallying 35 men, he crept close to the enemy bunkers. He laid down a grenade barrage. Then he ran forward to an

exposed knoll and opened a one-man pitched battle. He turned a light machine gun into the Red position. He caught live enemy grenades in mid-air and threw them back. Once he killed three men with his pistol. Before sunset Lieutenant Burke and 35 men had defeated 300. The lieutenant says:

"Every day, men who fought in Korea are coming home. They're finding jobs—partly because they and you and I own nearly 50 billion dollars' worth of Defense Bonds. For Bond savings—which protect our own families—are also building a great backlog of *national* prosperity. Reason enough for investing in Bonds—don't you agree?"

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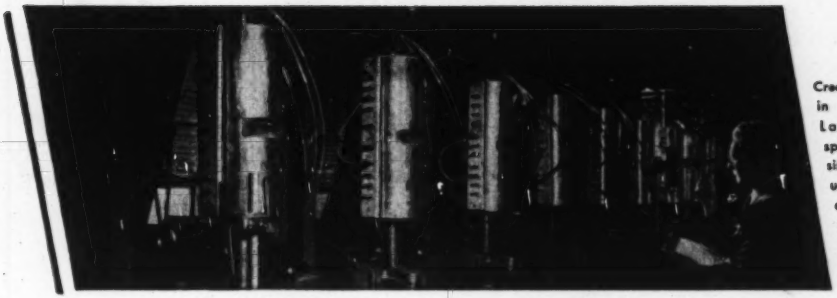

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INCO'S HIGH-TEMPERATURE ENGINEERING SERVICE

As industry progressed, it used higher temperatures and required metals and alloys to withstand these temperatures. Inco Engineers have endeavored to assist by analyzing the requirements and furnishing experimental data for the selection of the material.

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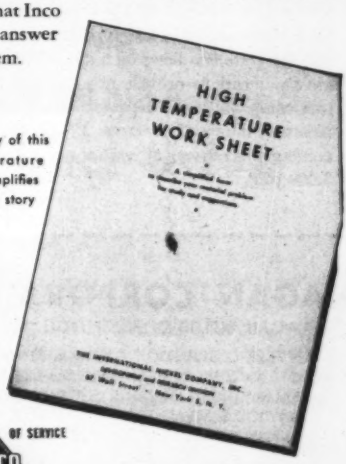
Send for your copy of this new High-Temperature Work Sheet; it simplifies gathering the full story of your problem.



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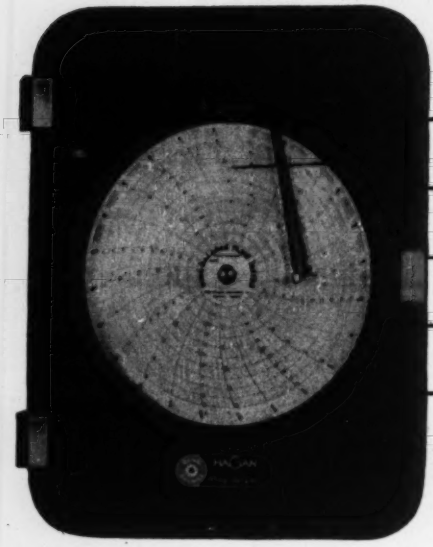

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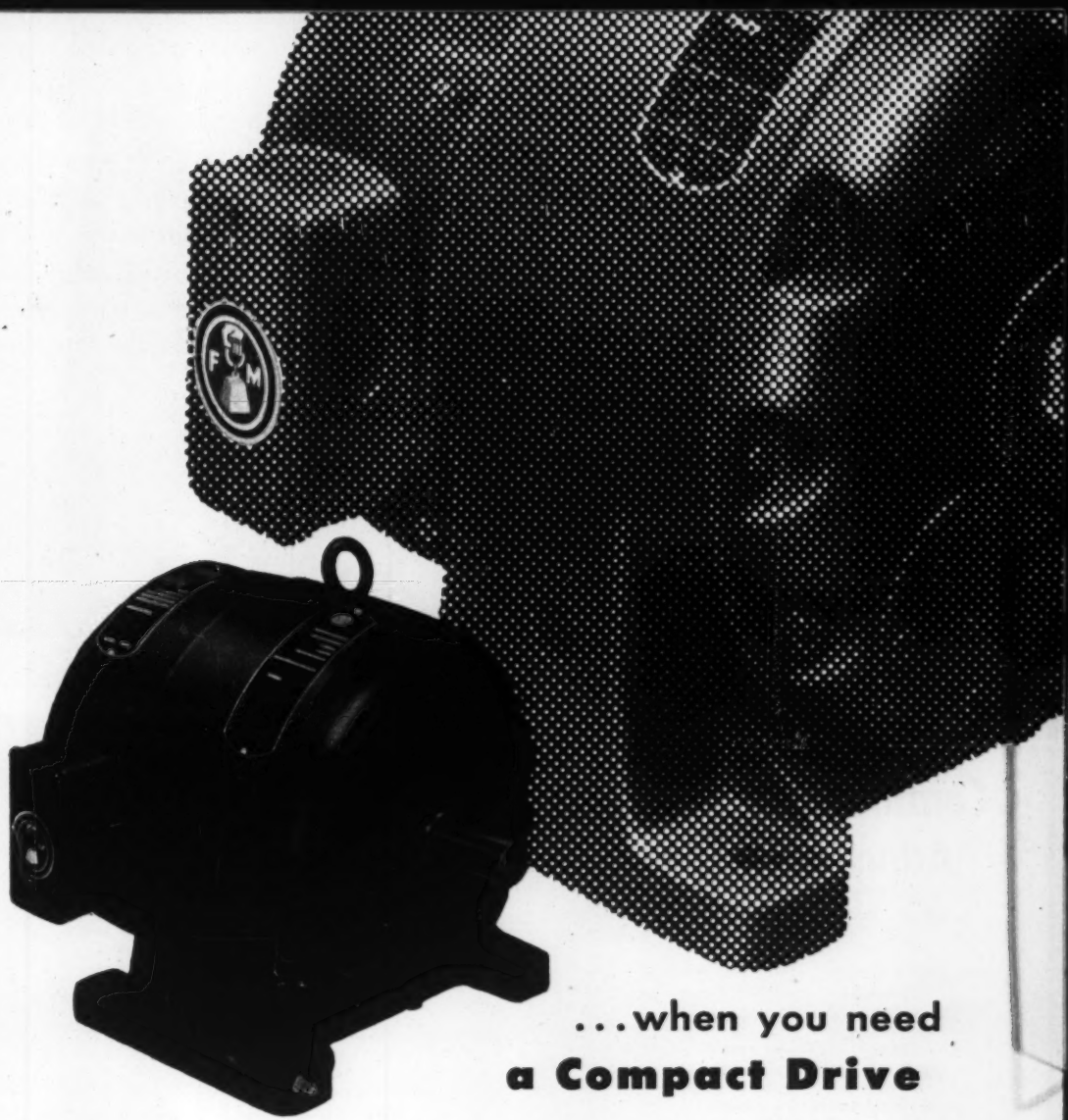

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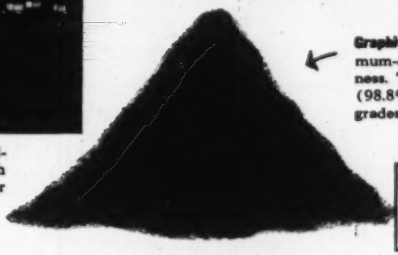

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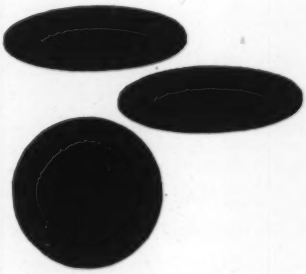

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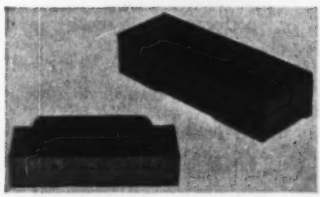

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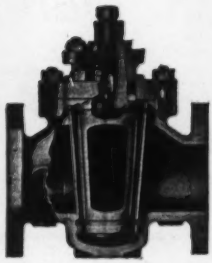
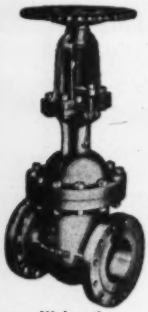


Walworth
Lubricated Plug Valve



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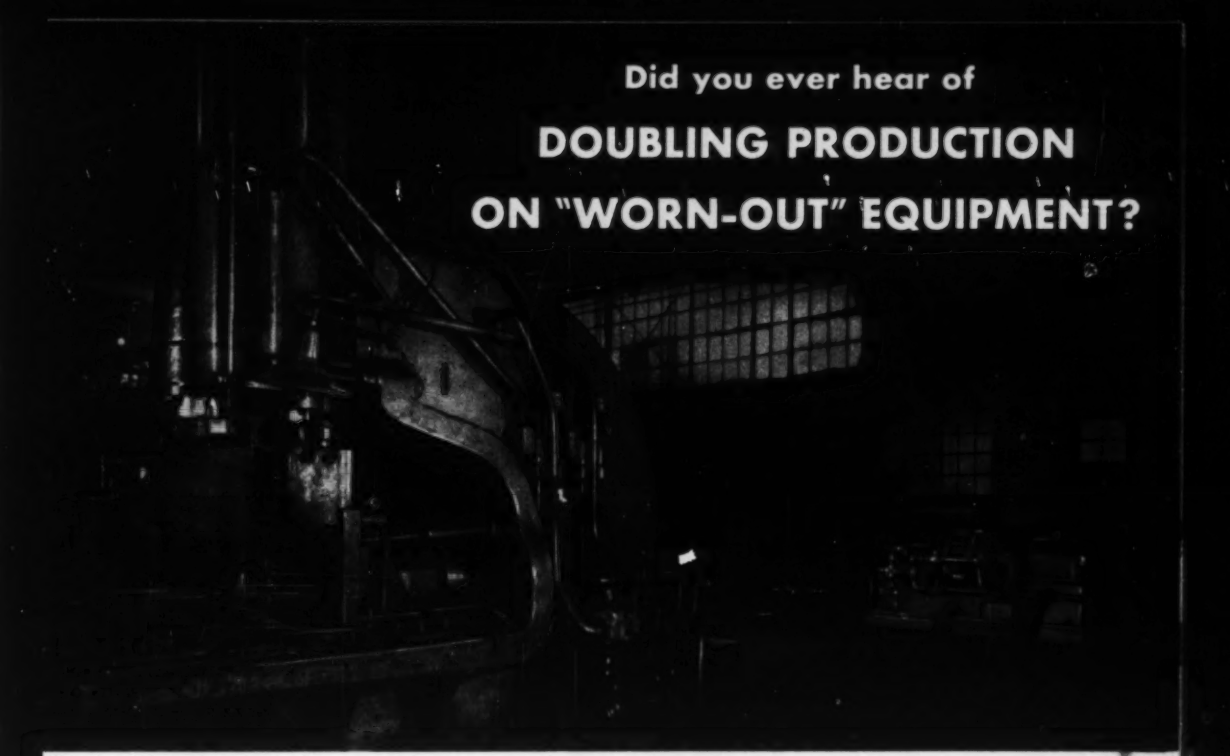

Did you ever hear of

DOUBLING PRODUCTION ON "WORN-OUT" EQUIPMENT?

You may gain a valuable hint from this story how Treadwell renovated an old belling machine with Oilgear Fluid Power

The belling machine used for flanging big boiler ends in the Treadwell Corporation plant at Midland, Pa., has seen many years of service. The machine was slow, was "down" a lot, maintenance was high and production was off.

A careful analysis indicated that the press itself was not at fault; the trouble was associated entirely with the water pump, storage and accumulator system used to power the press gripping and main rams.

Two alternatives confronted the Treadwell people. One was to repair or replace the water system. This ran into a figure prohibitively high. It would not solve the problem of high maintenance, faulty control, erratic performance, the shocks inherent in the system, the slow cycles.

The Treadwell people chose the second alternative and called in an Oilgear Fluid Power engineering representative. This is what happened:

A standard Oilgear Fluid Power system was installed, without modification to the press. The only change was some rearrangement of the piping system. The cost was from one-fourth to one-third that of repair to or replacement of the water power system.

The operation of the rams was speeded up, the total time for each cycle cut from 66 seconds to 34 seconds. Therefore actual press production was almost doubled. Because the power medium used is oil, friction and wear become almost non-existent. The space required is slightly less than that required by the water pump, but the bulky water tank and accumulator were eliminated altogether.

The interesting thing about this Oilgear Fluid Power, which is smooth, shockfree and dependable is that from the one source, power travels to actuate the gripping rams, then while holding them at gripping pressure, travels over to the main or shaping ram and actuates it; then the same power retracts the rams in order and goes into "neutral" during the next handling step.

The above is only one of a number of similar press "renovations" being performed with the use of Oilgear Fluid Power.

Think of Oilgear Fluid Power as similar in every respect to electric power. It is generated, piped, and applied in the same way, with these important exceptions: Oilgear Fluid Power can be used in linear movement where electricity cannot. Oilgear Fluid Power speed can be varied steplessly, smoothly, infinitely where electricity cannot — or only with costly, troublesome, extra equipment. Oilgear Fluid Power can be "bled" off, dissipated harmlessly in case of shock. Oilgear is massive, tremendous, resistless power that can be controlled with micrometer precision.

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OILGEAR

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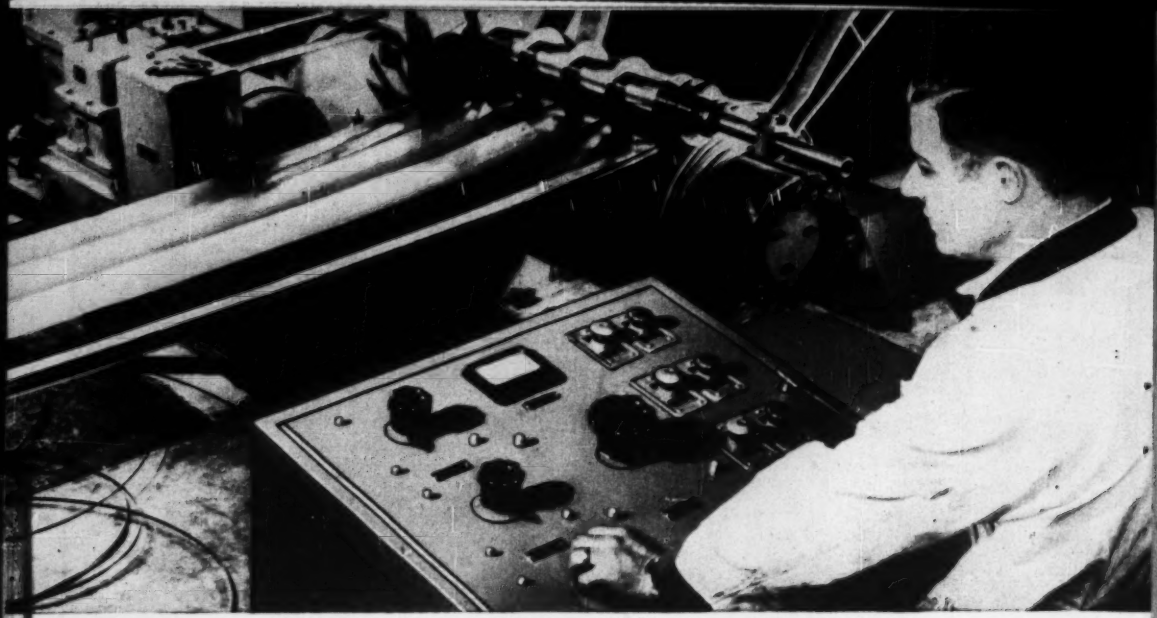
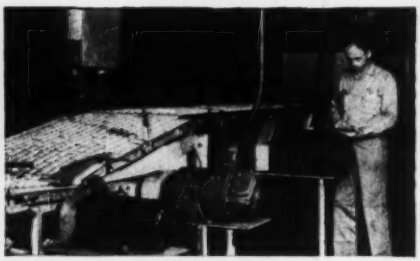


G-E SPEED VARIATORS, operated by central control panel (above) were chosen by E. F. Hauserman Co. of Cleveland, Ohio for its steel slitting operation. General Electric Speed Variators provide flexible performance in the 1–200-hp range at moderate cost. For even greater accuracy and versatility in automatic operation, these drives may include amplidyne or electronic regulators.

These G-E Adjustable-speed Drives can help you boost your output, too!



G-E THY-MO-TROL* drives assure the Keebler Weyl Baking Co. of Philadelphia of proper baking for many different products. This electronic control is particularly suited for precise adjustable speed in 1/4 to 10-hp drives—offers speed ranges to 100:1 and more.

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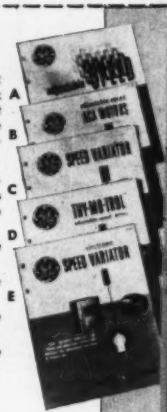

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☐ A This 26-page manual describes *all* four types of drives and where to apply them. Bulletin GEA-5334.

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Can You Tell Which of These Nordstrom Valves Are Designed for Chemical Services?

A

Fig. 1725 MA-4

B

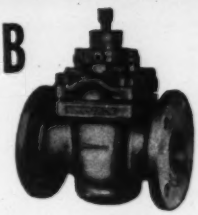

Fig. 8515

C

Fig. 614

A. This Nordstrom Valve is built of Type 316 Stainless Steel. It's recommended for oxidizing conditions such as nitric acid reactions. It is resistant to most organic acids and inorganic salts and alkalies.

B. Made of Monel, this valve is used in the food industries, along with nickel and stainless steel, for resistance to rust and corrosion. Sulphuric acid under reducing conditions may also be handled by it.

C. Like most Nordstrom process valves, this valve is available in screwed or flanged ends, straightway or multiport body patterns. It is Nordco Bronze, which is an acid resistant bronze for dilute sulphuric acid, organic acids, inorganic salts and alkalies.

D. A three-way Nordstrom Multiport valve may replace several straightway valves in process lines and also eliminate other fittings like tees and elbows. This valve is semi-steel, usually used in lines with cast iron pipe and fittings.

E. Often in batching, blending and other process applications, a gear operated valve may be needed. Here, a Nordstrom Hypreseal valve, for pressures to 2500 lb, is equipped for gear operation.

F. For handling caustic liquors in the sulphate pulp industry, viscose rayon plants, etc., this Nordstrom Valve of Type 2 Ni-Resist is widely used. It is also used in plastic and food industries and elsewhere where freedom from copper contamination is desired. It is also resistant to hydrogen sulphide as encountered in sulphide water, industrial water and petroleum oils.

G. Nordstrom valve of Hastelloy B, with Merchrome hard faced plug, is resistant to acid chlorides such as ammonia or zinc chloride. Not recommended for oxidizing conditions.

D

Fig. 3403

E

Fig. 1949

F

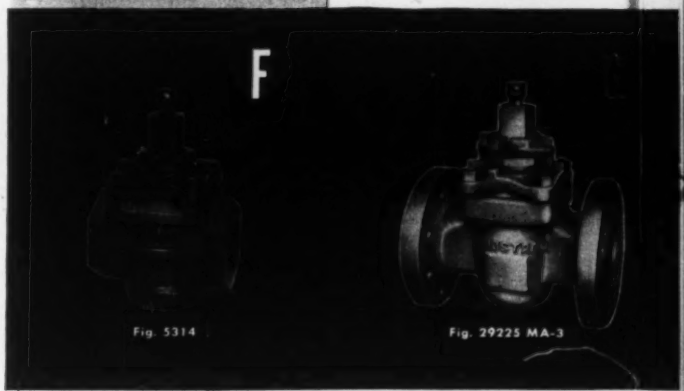

Fig. 5314

Fig. 29225 MA-3

In short, all of these Nordstroms are recommended for some types of process installations.

Nordstrom now builds a wide range of lubricant sealed valves for the chemical and process industries—many body patterns and pressure classes, sizes for nearly every line, flanged or screwed ends and a variety of most commonly specified erosion and corrosion fighting metals.

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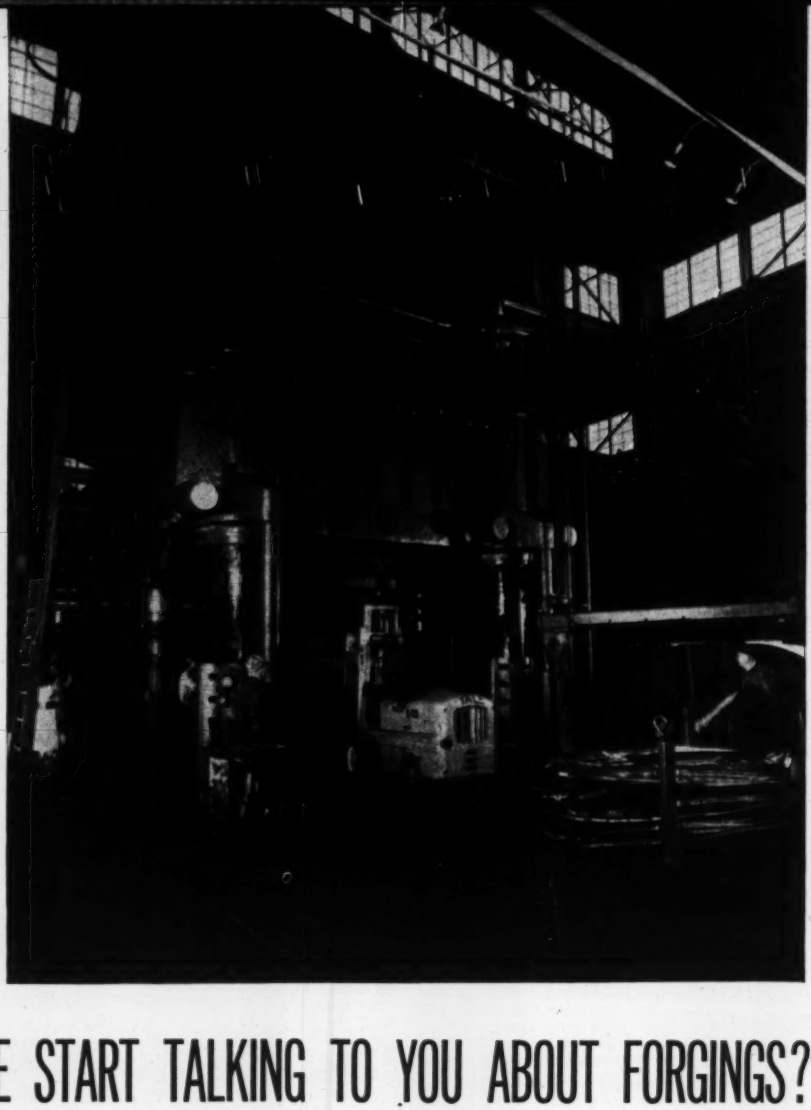

WHERE DO WE START TALKING TO YOU ABOUT FORGINGS?

We suspect that a lot of people think Alcoa only smelts and refines aluminum. If you are one of these, we should tell you first that Alcoa makes almost everything in aluminum—including forgings. We have big forge shops in Cleveland, Ohio; Vernon, California; and New Kensington, Pennsylvania. In fact, these are the largest aluminum forging facilities in the country. They have been making forgings for 30 years . . . backed by Alcoa's 64 years of aluminum experience.

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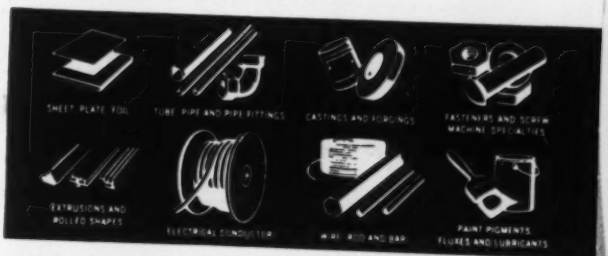

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Here are the keys that have opened the way to adequate, reliable power for many plants — small and large. They have eliminated the penalty paid due to poor power factor, surge loads and adverse current characteristics.

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Look at the list! Would compact in-plant power generation unlock your plans for plant expansion . . . eliminate the need of using purchased power at rates based on *high* peak demand values . . . add to current capacity? The answer is yes—and it can mean the difference between profit and loss in your plant.

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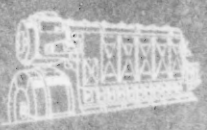
Put Your Power Costs and Performance in Order



1 ***Handle Peak Demand*** . . . reduce peak demand values for lower purchased power rates.

2 ***Power Factor*** . . . in-plant power generator can eliminate power factor penalties.

3 ***Emergency Power*** . . . insurance against lost production and damage resulting from line failures.

4 ***Handle Surge Loads*** . . . that may now be affecting current characteristics of entire plant.

5 ***Plant Expansion*** . . . need not be restricted due to lack—or expense—of ample power.

6 ***Useful Heat*** . . . lube oil, water and exhaust heat can be turned from waste to profit.

7 ***Chemical Value*** . . . exhaust gases are high in free nitrogen—available for economical fixation of nitrates, ammonia, etc.

8 ***Insurance Advantage*** . . . of diesel over gasoline engine, for example, will soon pay for installation.

9 ***No Weather Worries*** . . . ice, snow, sleet, wind storms can't stop plant operations.

10 ***Handle Increasing Load*** . . . in-plant power economically adds to current capacity as loads increase.

11 ***Fuel Economy*** . . . use diesel oil, natural gas or sewage gas for added economy.

12 ***Remote Locations*** . . . distance from transmission lines needn't curtail plant expansion.

13 ***More Compact Power*** . . . Fairbanks-Morse engines give you more power per foot of floor space, more power on present foundation.

14 ***Minimum Attendance*** . . . Fairbanks-Morse in-plant generating sets require far less supervision or maintenance.

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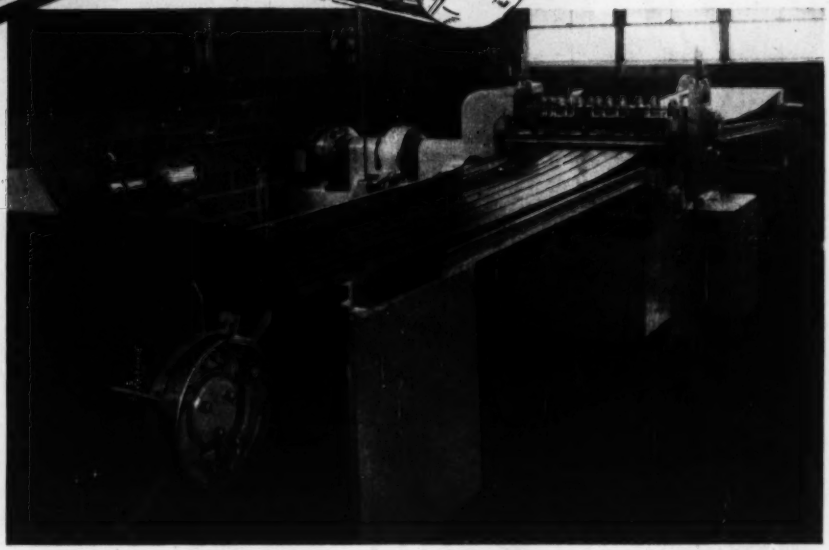

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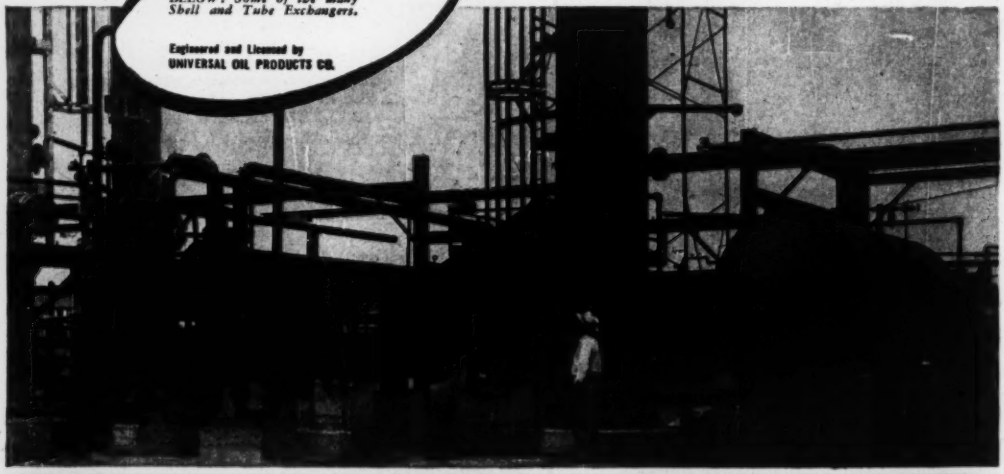

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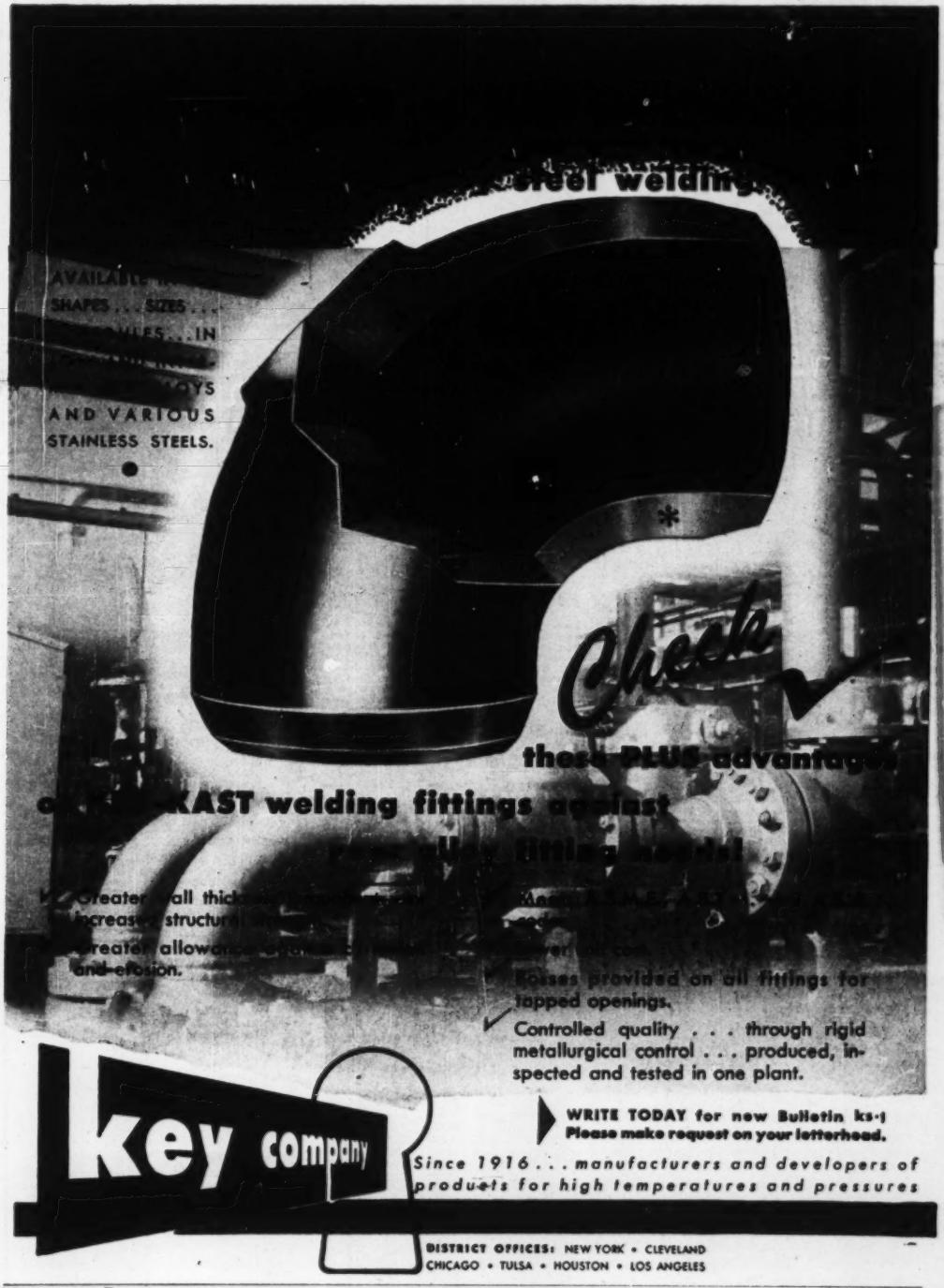
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PROCEEDINGS OF THE FIRST U. S. CONGRESS OF APPLIED MECHANICS

To be published January 1953. $20.00—Prepublication price, effective to December 15, $15.00—These Proceedings contain 125 research papers by leading experts and five general survey lectures by distinguished authorities in some of the major branches in the applied mechanics field. The book provides a compendium of recent advances made in connection with many of the most significant problems encountered throughout modern applied mechanics.

GENERAL DISCUSSION ON HEAT TRANSFER

Published November 1952. $10.00—This is an authoritative reference on a decade's development in heat transfer and in the design of apparatus relating thereto. Within its 500 pages are 93 articles, complete accounts of discussions, and numerous bibliographies providing first-hand information on these specific subjects: heat transfer with change of state; heat transfer between fluids and solids; conduction in solids and fluids; radiation, instrumentation, measurement techniques and analogies; special problems such as heat transfer in turbine blade cooling, in liquid metals, in gas-turbines, in piston engines, the mercury boiler, etc.

DIESEL FUEL OILS

Published in 1948. $3.50—Reviews refining techniques, the chemistry and properties of the preferred hydrocarbons used in the Diesel power field, and the theory and fundamental factors affecting the combustion of Diesel fuel oils.

PROCEEDINGS, 1951 OIL AND GAS POWER DIVISION CONFERENCE

Published 1952. $3.00—Subjects dealt with include engine governing; the effect of charge temperature and pressure on rating of Diesel engines, Diesel engine crankcase explosions and damage prevention therefrom; modern gas engine; operation of direct-connected engine driven compressor as a gas generator; exhaust snubber design for gas engines; water cooling equipment for Diesel and gas engines; and engine operation and maintenance from the operators and manufacturers' viewpoints.

INTERNAL COMBUSTION TURBINES

Published 1949. $2.25—Gives consideration to world conditions under which gas turbines for land and sea use are being developed, the principal factors influencing the part-load performance of different gas-turbine engine schemes, gas turbine fuel problems, heat-flow in gas turbines, and the three dimensional flow theories for axial compressors and turbines.

MODERN REHEAT TURBINES AND BOILERS

Published 1952. $2.00—Aspects of reheating treated include advantages and disadvantages of the reheat cycle; normal, start-up, quick start-up, and shutdown of modern reheat boilers; design factors relating to performance and operation of reheat boilers; performance of several new reheat boilers and special features of operation; starting schedules after shutdown of various durations; reheat economies; conversion to centralize control of auxiliaries; temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

GAS TURBINE PROGRESS REPORT—1952

Published December 1952. $3.00—This Report covers gas turbine applications in automotive, railroad, aviation and marine fields, in the central station and in specialized industries. It also surveys the progress that has been achieved in improving materials, cooling methods, fuels, and performance of gas turbine components. Probable future trends are forecast, and consideration is given to the important problems which have to be solved before the gas turbine can be more generally applied.

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To be published January 1953. $2.50—The Manual gives shopmen a practical substitute for the Unified and American Screw Thread and the Screw Thread Gages and Gaging Standards. It contains only the most used and essential standard dimensions, concise descriptions of the thread features and applications, and important related information not found in the Standards.

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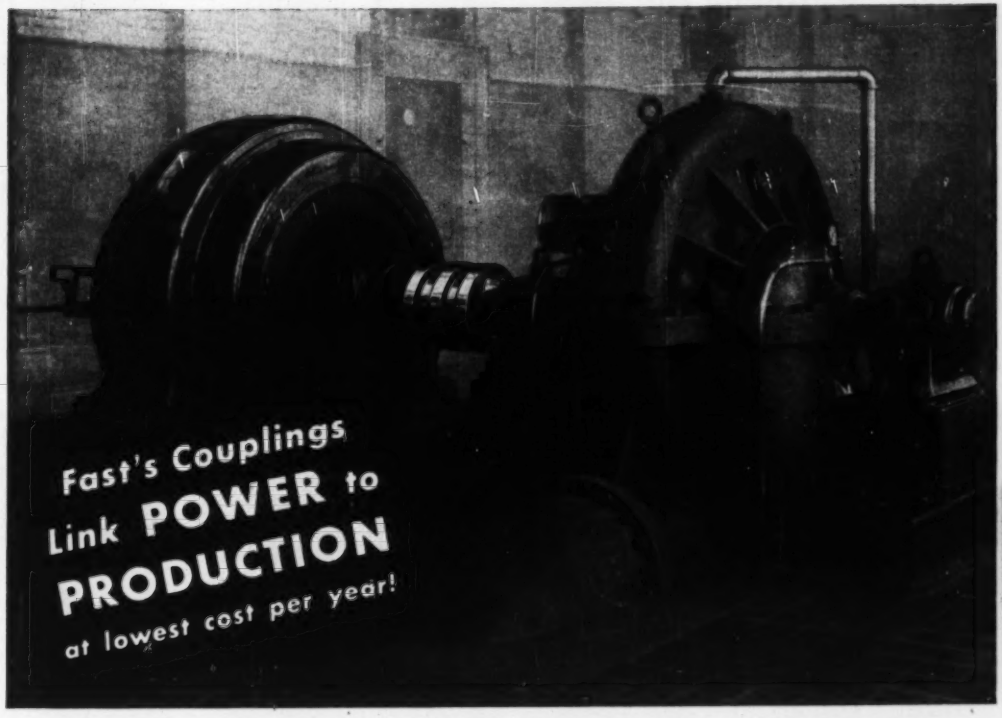

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THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

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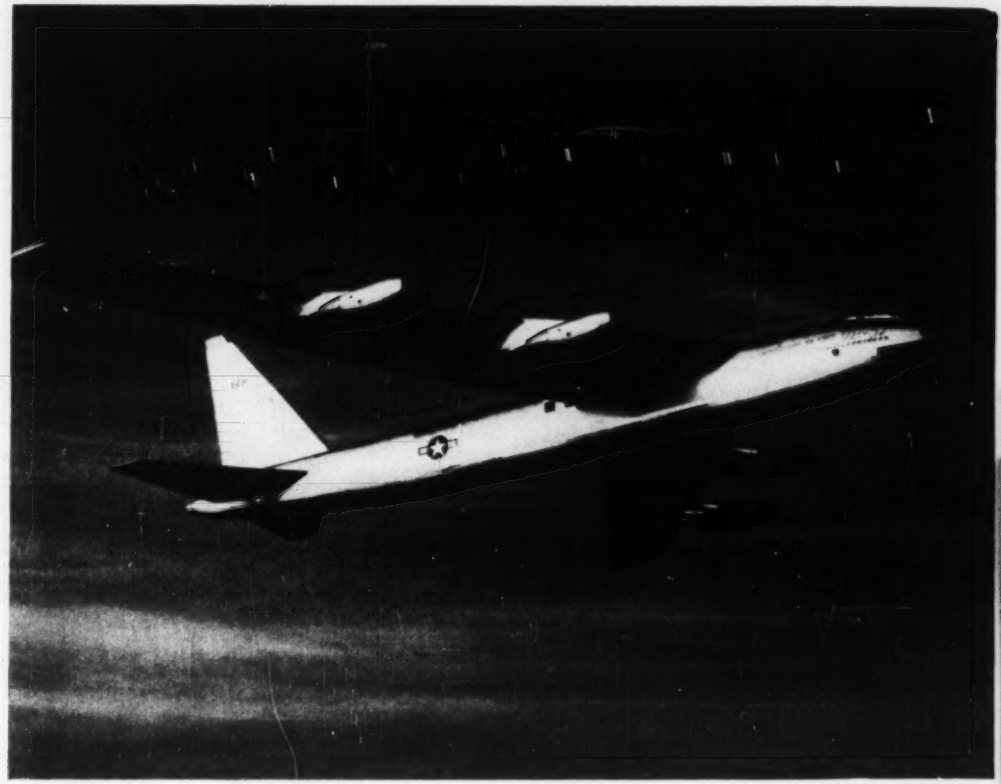

This is the Boeing team's jet heavyweight

Here is a flight shot of the giant Boeing B-52 Stratofortress. An eight-jet heavy bomber, the Stratofort is a fast, husky teammate to the B-47 Stratojet medium bomber. It's 153 feet long, measures 185 feet from wing-tip to wing-tip, and is powered by eight Pratt & Whitney J-57 engines. Speed and other performance details are carefully guarded secrets.

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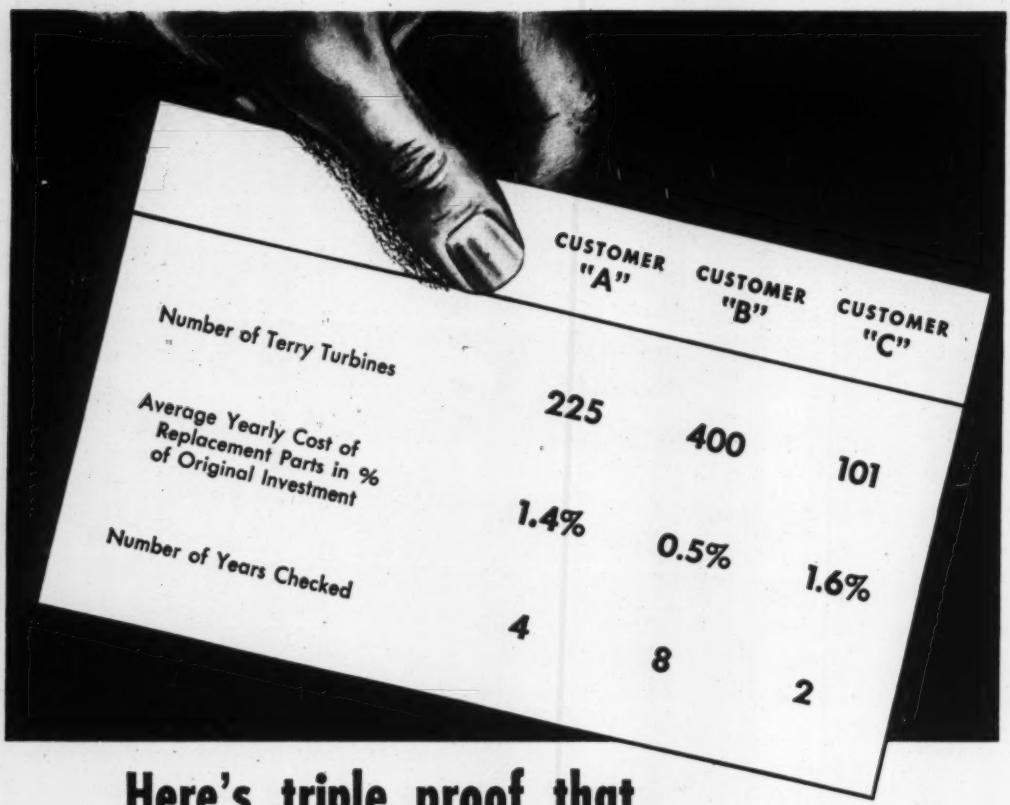

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Send for further information about these low-maintenance turbines. Bulletin S-116 describes the many advantages of the Terry solid-wheel turbine. For multistage turbines, ask for a copy of Bulletin S-146.

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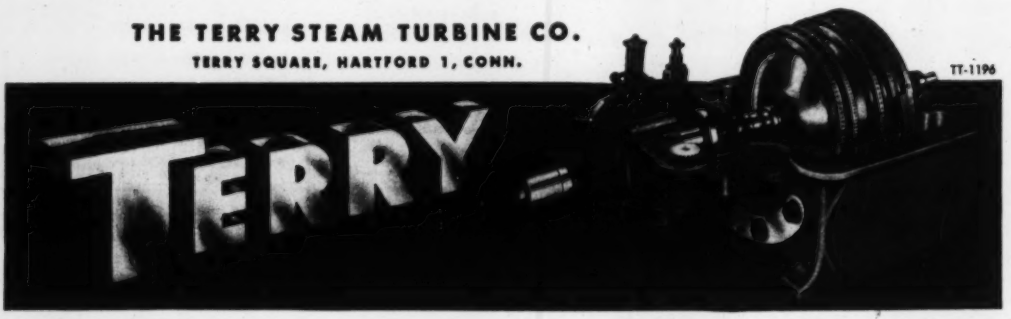

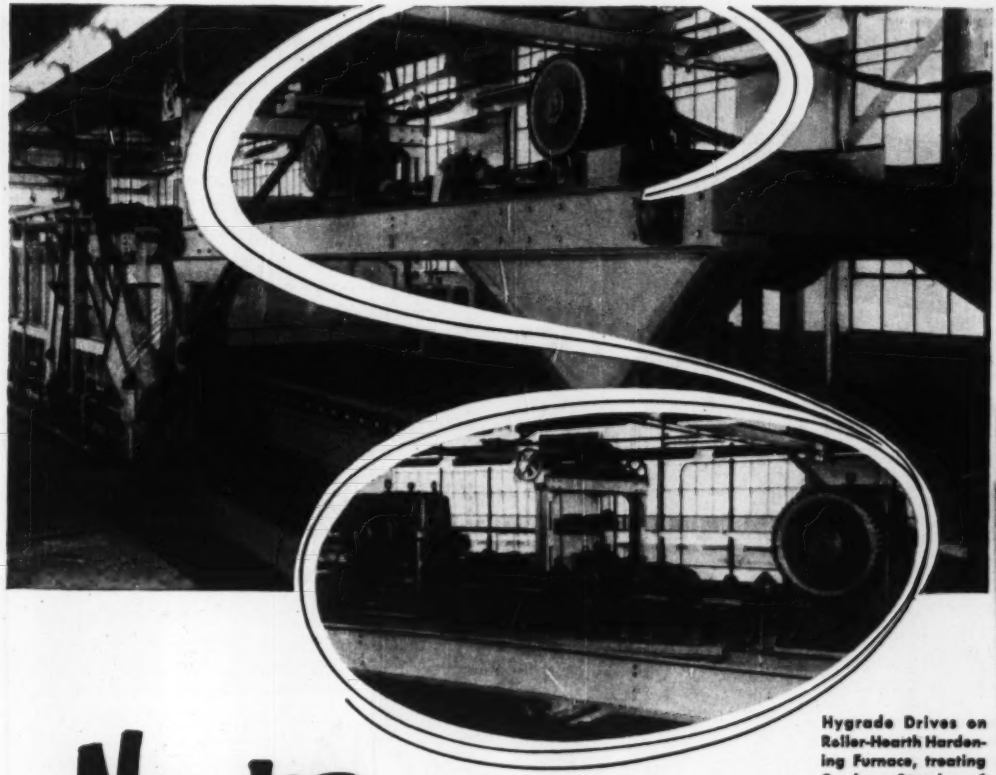

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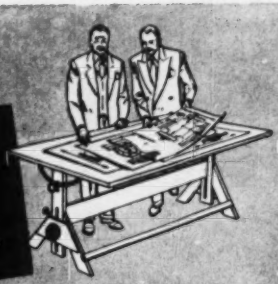

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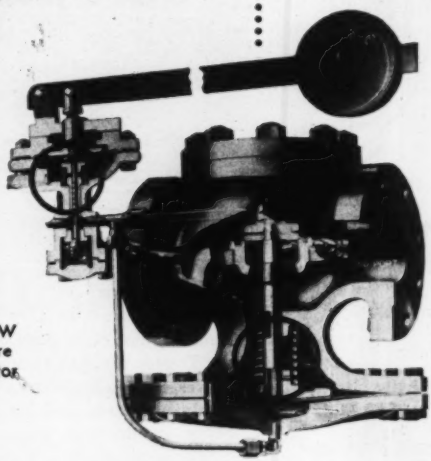
...protects springs

FOR LONGER LIFE

In the Spence Regulator, the springs are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life. This is only one of the many Spence design features that assure dependable, accurate regulation year after year. That means less down-time, less time and money wasted on replacement of parts.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governor and many other types. Write for bulletin 100 giving full details.



Type EW Pressure Regulator

A few other design features:

SECO METAL SEATS AND DISCS—Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

LARGE BALANCED METAL DIAPHRAGM located in a cooled zone with a condensate seal above and below it, never has to be replaced under normal conditions.

PACKLESS CONSTRUCTION—All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . reduces valve stem wear and eliminates time-consuming maintenance.

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ZURN engineered

Our 50th Anniversary

LPD STRAINERS (Low Pressure Drop)

THEY PERMIT HIGH RATES OF FLOW WITH REMARKABLY LOW PRESSURE DROP (LPD) AND IMMEASURABLY IMPROVE THE HANDLING OF FLUIDS (OIL, CHEMICALS, WATER) THROUGH PIPE LINES

WHATEVER IS DONE to compensate for a loss of pressure usually results in an increased cost of handling liquids in pipe lines. But, compensation for the loss of pressure is usually unnecessary when Zurn Engineered Strainers are installed. Instead, a *reduction of pressure loss* is usually obtained. Zurn Low Pressure Drop (LPD) Strainers are design improved for correct circularity; have smooth inner walls combined with correctly sized and perforated baskets which reduce pressure loss and afford maximum protection for all types of mechanical units connected with pipe lines.

Zurn Strainers, are held to close manufacturing tolerances for materials, shape, and dimensions assuring the utmost in strength and safety. Zurn Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; municipal water systems; ships and high temperature, high pressure installations. Zurn Fluid Handling Engineers are available for consultation on your fluid handling problems.

There is a ... Strainer for Every Fl... Purpose.

Write for Pipe Line Strainer Manual No. 951, including previously unpublished pressure drop data.

J. A. ZURN MFG. CO.
INDUSTRIAL DIVISION • ERIE, PA., U. S. A.
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Please send me Pipe Line Strainer Manual No. 951

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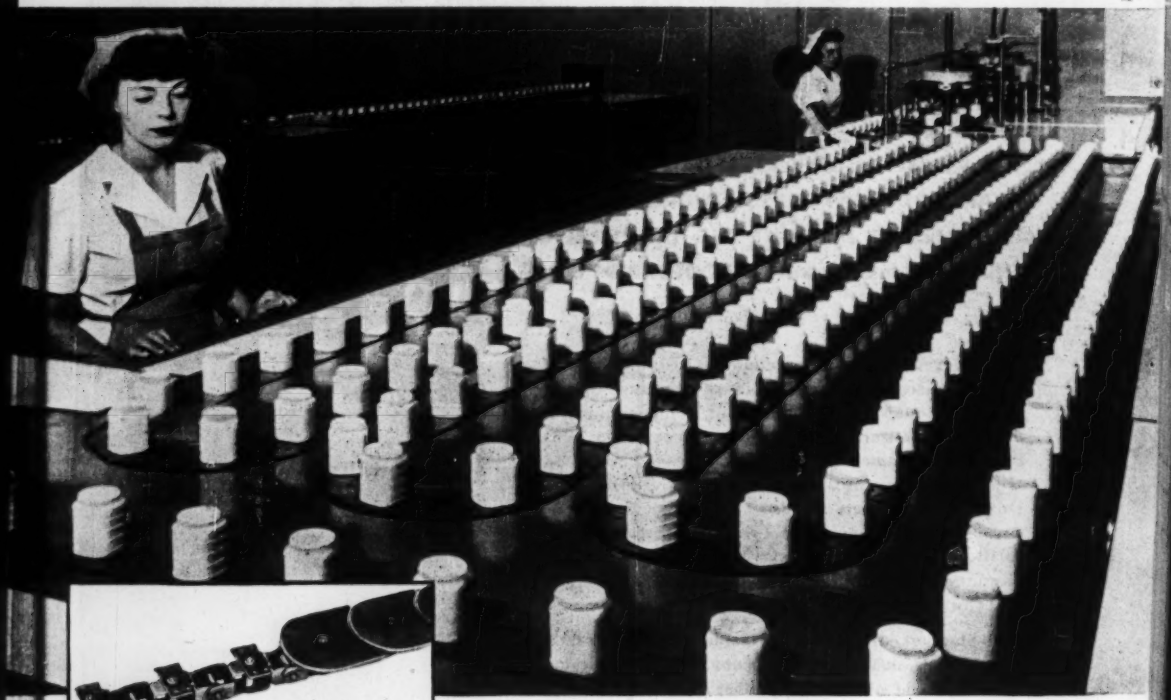
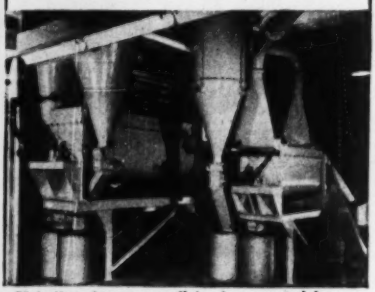


On this Link-Belt universal crescent flat top conveyor chain, jars of baby cream take this irregular path, each always riding separately on its own chain top plate.



Volatile solvents are efficiently recovered by a Monotube Dryer, one of many Link-Belt products widely used in chemical processing industry.

The mammoth chemical industry moves and processes millions of tons of materials with LINK-BELT equipment

IN almost every phase of the huge chemical industry, you'll find Link-Belt conveying, processing and power transmission machinery at work. Likewise at quarries, mines and farms . . . in refineries, mills and factories—Link-Belt equipment handles materials every step of the way. This efficient equipment provides the high-capacity, trouble-free operation that brings more goods to more people at a lower price.

Hundreds of Link-Belt products serve all industry. They are backed by a continuous research program and a nation-wide engineering organization that have led the way to many advances in the field of mass production. Next time you have a conveying, processing or power transmission problem, remember that Link-Belt's vast facilities are at your call.

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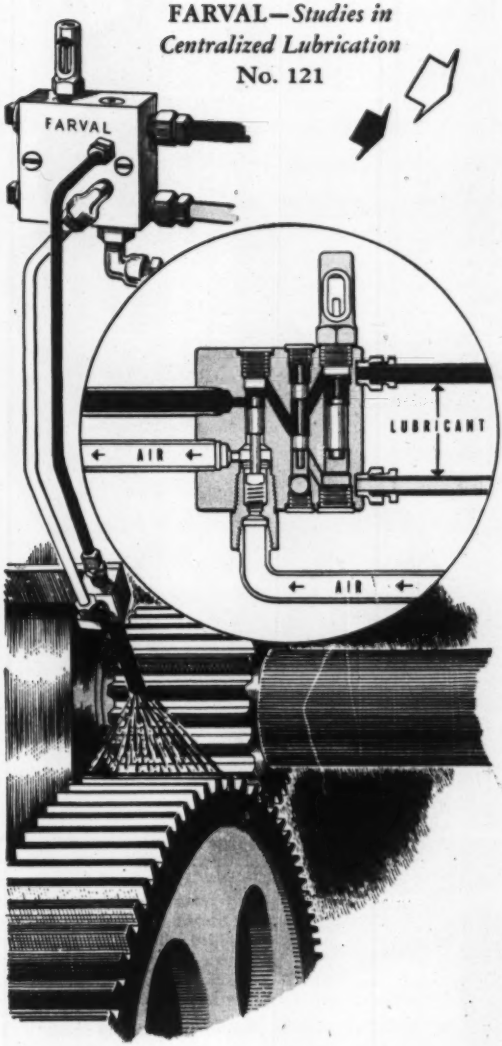
FARVAL—*Studies in Centralized Lubrication* No. 121

FARVAL SPRAY VALVE

meters lubricants to slide surfaces and open gearing



THE value of controlled spraying of lubricant on open gearing, slide surfaces, etc., with the Farval Spray Valve is proved by two years' successful experience in hundreds of plants.

By an ingenious adaptation of the familiar Farval Dualine Valve, either grease or oil is sprayed through a nozzle—on any desired area, in any desired amount, and at any desired interval. The spray valve unit can be added at any point in a regular Farval Dualine System wherever compressed air is available—or a complete system may consist entirely of spray valves, served by either manual or automatic central pumping unit.

Compressed air from the supply line is directed through the spray valve, which meters air to the delivery nozzle just as lubricant is metered. By a unique arrangement, the lubricant valve also turns on and shuts off the air. Thus the quantity of air used is limited to the amount needed to spray each delivery of oil or grease, without exhausting or reducing pressure. Positive cut-off of lubricant by the Farval valve after each delivery eliminates bleeding from the nozzle—no waste, no mess, no trouble.

The Farval Spray Valve has been thoroughly tested in service and is now in use on a wide variety of machines and equipment. It has demonstrated its ability to supply lubricant efficiently and economically to open gearing, slide surfaces, in fact, wherever a standard Farval Dualine closed system is not readily adaptable.

Write for a copy of Farval Spray Valve Bulletin No. 60 for a full description, with illustrative diagrams and installation data. The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

These diagrams illustrate the action of the Farval Spray Valve in delivering a measured quantity of oil onto open gearing. One or more spray valves can be incorporated readily into any Farval Dualine System. Or spray valves can be installed independently, served by their own Farval manual or automatic central pumping unit.

The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

T F

For up-to-the-minute facts, see your Taylor Forge distributor

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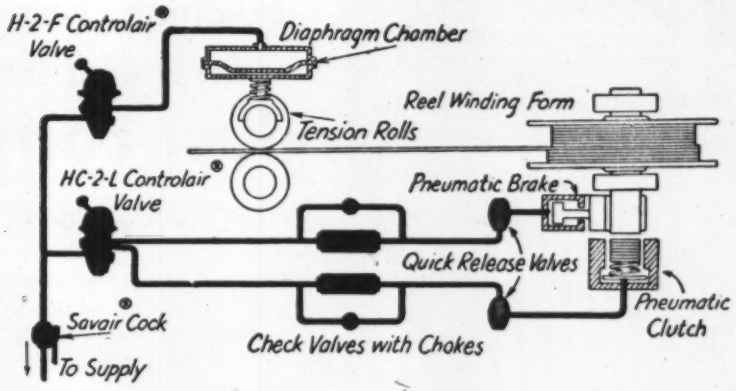
TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Pneumatic controls cut labor costs

and provide automatic operation of wire drawing machinery



AN Eastern steel wire manufacturer needed a control system that would enable just one man—instead of two—to operate his wire drawing and windup machinery. Tension on wire forming rolls had to be closely controlled to maintain wire size. The control system had to prevent the operator from applying the brake and clutch simultaneously and from applying either one too fast.

The simple, low-cost pneumatic control system shown above satisfies these requirements. Air pressure to the pneumatic diaphragm chamber determines the tension on the rolls. This pressure is regulated by a Westinghouse Controlair pressure-graduating valve.

Air pressure to the pneumatic brake and clutch is graduated by another Westinghouse Controlair valve that prevents simultaneous application of brake and clutch. A choke in parallel with a single check valve guarantees a gradual build-up of pressure even if the operator throws the handle of the Controlair valve instantly from neutral to full on. A quick release valve in each line assures rapid release of brake or clutch.

Maintenance costs and wire breakage are now extremely low because the control system prevents shock loads caused by sudden full application of brake or clutch.

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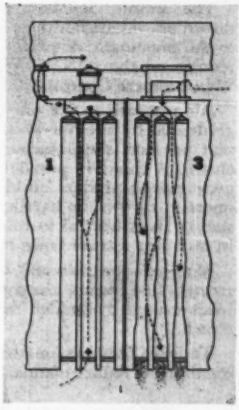
3. Shaking and cleaning involves only one compartment at a time. During this short period the vigorous reciprocating shaking and reversed air flow insures cleaning of bags.

4. Any compartment may be cut out of operation as long as desired for bag repair, on the clean air side, and all other compartments will remain in operation.



Norblo also builds centrifugal and hydraulic dust collectors, exhaust fans, cement air cooling systems, and portable type dust collectors. Write for literature on any of these.

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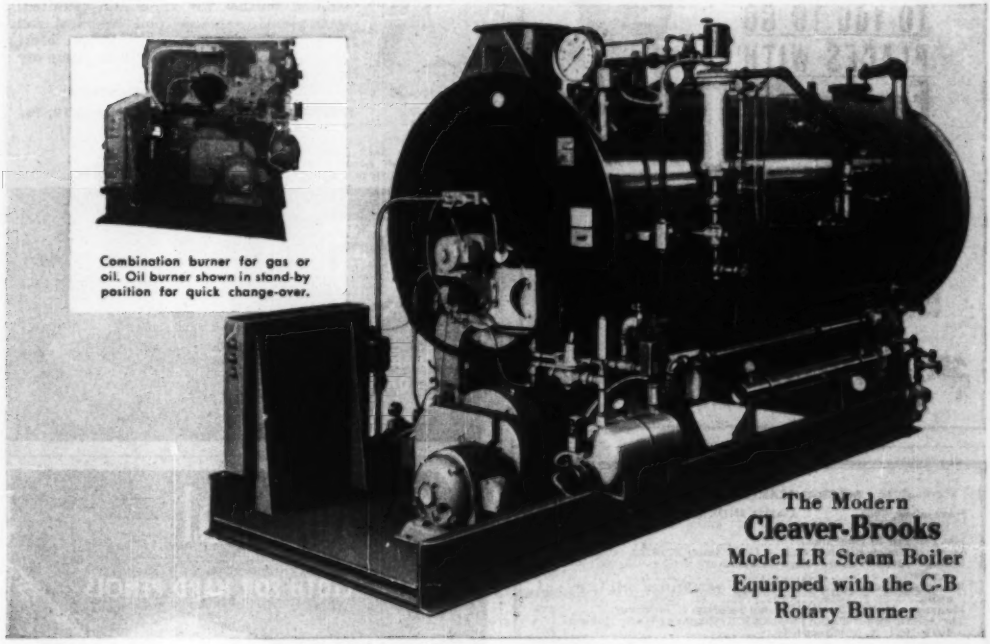

Combination burner for gas or oil. Oil burner shown in stand-by position for quick change-over.

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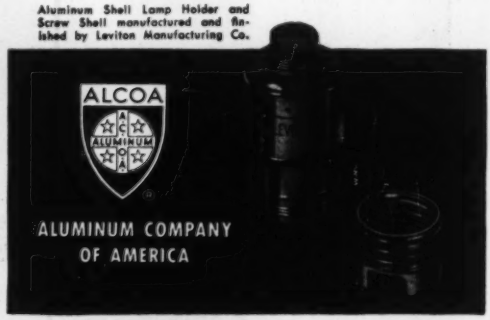

ALUMINUM COMPANY OF AMERICA

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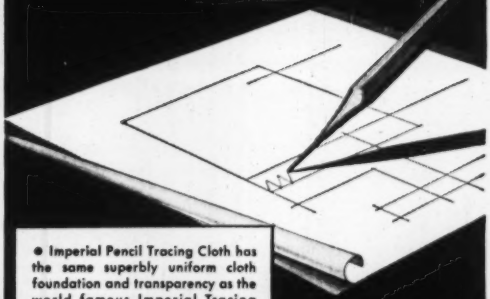

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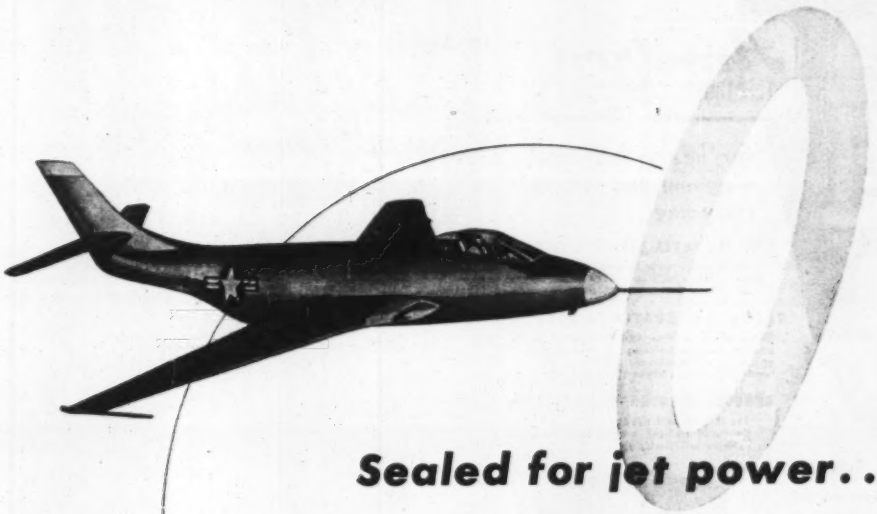
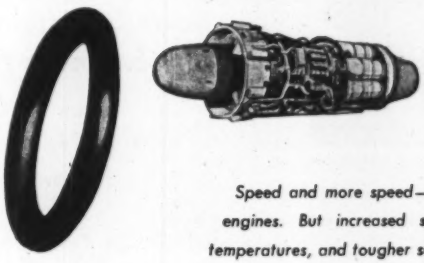


Sealed for jet power....



Speed and more speed—that's the goal for designers of today's jet engines. But increased speed calls for increased power, higher temperatures, and tougher service conditions.

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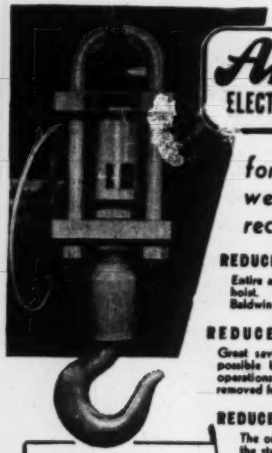

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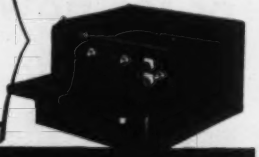

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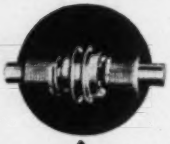

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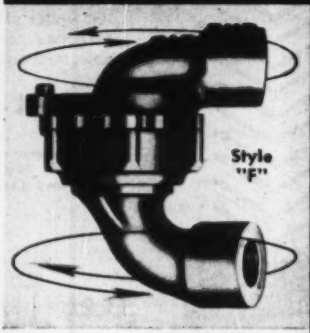
FLEXO JOINTS

for pipe lines that *move!*



For unrestricted flow of steam, air, or fluids through moving pipe lines or to equipment in motion.

Complete 360° swing. The strength of pipe with the flexibility of hose. Only four parts assure long wear, low maintenance. No springs, small or loose parts. Four styles in standard pipe size, ¼" to 3".

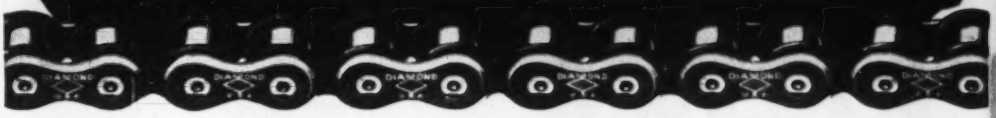
WRITE for full information and prices.

FLEXO SUPPLY CO. Inc.

4652 PAGE BLVD. ST. LOUIS 13, MO.

In Canada: S. A. ARMSTRONG, Ltd., 1400 O'Connor Dr., Toronto 13, Ont.

Why is there a difference in ROLLER CHAINS?



For the past sixty-two years the Diamond Chain Company has continuously devoted its efforts to the attainment of higher quality in the product, and the constant expansion in the use of roller chain as a superior mechanical means of power transfer. . . Research, testing and engineering developments have always been factors of first consideration at Diamond Chain.

FOR EXAMPLE:—

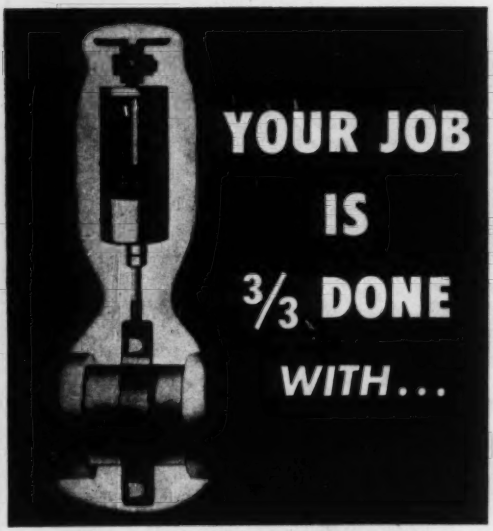
1. Diamond Chain has improved the pin and bushing holes in the link plates by proper pitch hole preparation. Pins and bushings are case hardened.
2. Diamond Chain has long recognized that certain types of internal stressing of chain parts would increase fatigue resistance. To this end, link plates have been specially processed and chain rollers and other parts have been shot-peened since 1944.
3. Diamond Roller Chain is constantly improved. Time tested improvements become standard for production as soon as established and certified.
4. Fully equipped and well staffed chemical and physical testing laboratories have made it possible to control raw material specification, their treatment and processing.
5. Diamond Chain has established production processing methods and quality controls through multiple inspection to insure uniformity of high quality in continuous production runs.
6. As always the Diamond trade-mark on roller chain is the Hall Mark of Quality.

DIAMOND CHAIN COMPANY, Inc.

Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Indiana

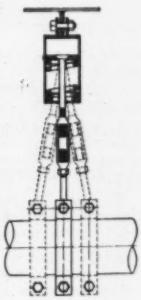
Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER



BLAW-KNOX
FUNCTIONAL HANGERS

Internal swivel action accommodates pipe line movements in ALL DIRECTIONS



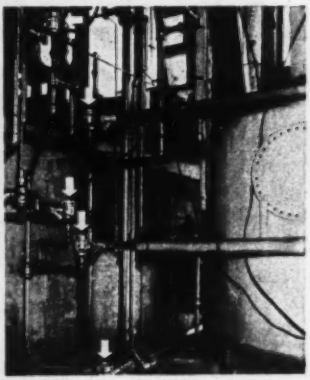
The patented Internal Swivel Action, found only in Blaw-Knox Functional Type Spring Hangers, allows *lateral* and *axial* movements within reasonable limits, as well as vertical pipe line movement. This represents a decided improvement over hangers designed for vertical movement only. The pivotal connection within the hanger itself permits the pipe line to move at a considerable angle to the hanger, which is attached to a fixed support.

Because they provide for horizontal movement, Blaw-Knox Functional Hangers help piping engineers solve difficult hanger problems arising from pipe line expansion or contraction, vibration, and pulsations. Catalog No. 51 will give you complete information on Blaw-Knox Pipe Hangers, Vibration Eliminators and Supports—as well as valuable technical data on hanger design. Write for your copy today—no obligation.

BLAW-KNOX CONSTRUCTION COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pennsylvania

BLAW-KNOX PIONEERS IN THE DEVELOPMENT OF FUNCTIONAL HANGERS VIBRATION ELIMINATORS

Steam Trapping for Process Equipment

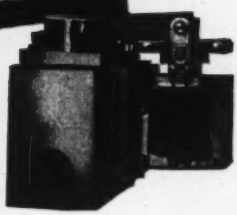


This still at Farmers' Chemical Laboratories, Kalamazoo, Mich. requires steam traps with the following characteristics: 1. Rapid air venting for quick starts from cold— 2. No adjustment or valve and seat changes are needed for different pressures — 3. As easy to install as a pipe fitting — 4. Small size, low first cost, minimum maintenance.

These are the characteristics which decided Mr. Paul H. Todd, owner, to use Sarco No. 9 balanced pressure thermostatic Steam Traps throughout his modern plant. He is well satisfied with the results.

For equal success in getting maximum efficiency from your steam heated process equipment, write for Bulletin 250-13 to **Sarco Company, Inc.** Empire State Bldg., New York 1, N. Y. There is no obligation.

High Pressure SOLENOID VALVES . . .



have working pressures range as high as 3000 psi. Specifically designed for remote push button control of hydraulic systems, as well as for the handling of any non-corrosive fluids. Poppet construction eliminates leakage. Impregnated coils are oil and moisture resistant. Unit can be mounted in any position. Available in 110-220 A.C.

Write For Illustrated Circular G.

WATERMAN ENGINEERING Company
725 CUSTER AVENUE
EVANSTON ILLINOIS

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimu minsertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

MECHANICAL ENGINEER

Established consulting firm, New York area, desires Mechanical Engineer, capable supervising starting, testing, operating and correcting troubles of steam-electric station equipment. Plant betterment work involving considerable traveling. Technical education, and plant operating or betterment experience required. State education, experience and salary desired.

Address CA-4097, % "Mechanical Engineering."

CHEMIST

Chemist experienced analyzing power plant problems, capable prescribing water treatment methods and writing equipment specifications, training and supervising plant chemists and operators. State education, experience, salary desired.

Address CA-4096, % "Mechanical Engineering."

MECHANICAL ENGINEER
Experienced or interested in
MACHINE DESIGN

Permanent position for graduate, age 28–50. Previous experience in excavator design desirable but not a must.

Company is small but progressive and is presently expanding production facilities. Sales volume $8,000,000 per year, Dunn and Bradstreet AA1, approximately 800 employees including steel foundry. Population of Marion, Ohio, about 37,000. Product—excavators 1/2 yard to 2-1/2 yard.

Applicant must be board designer well grounded in engineering mechanics and machinery layout. Salary open. Write or apply giving complete qualifications and references. Your reply will be held confidential.

THE OSGOOD COMPANY
CHENEY AVENUE
MARION, OHIO
ATTN: J. E. Collouette, Chief Engr.

ASSISTANT TO GENERAL SERVICE MANAGER

Progressing earthmoving equipment distributorship with territory in Pennsylvania, Ohio and West Virginia. Must be college graduate with engineering degree, between 26 and 40. Assist in supervising and administering shop and field repair service at six locations. Leading lines handled include "Caterpillar" and Bucyrus-Erie. Previous experience not required in these lines. Send complete personal and business background. Recent snapshot also required.

H. J. ZUKAUSKAS,
Beckwith Machinery Company,
6350 Hamilton Ave., Pittsburgh 6, Pa.

No phone calls please!

SUPERINTENDENT OF OXYGEN PLANT

Graduate chemical or mechanical engineer, with minimum of three years operating experience in oxygen plants, required for petro-chemical plant of large chemical manufacturing company. Must be able to relocate in Louisiana. Please submit full resume and indicate salary desired.

Address CA-4116, % "Mechanical Engineering."

STOKER SALES TRAINEES AND SALESMEN

Prominent manufacturer of mechanical stokers for power and heating plants solicits applications for salaried positions, or from present salesmen of stokers, boilers, or similar equipment. Openings for permanent employment are available in several district sales offices. Some prior or present employment in similar work desirable but not absolutely necessary if other qualifications suitable. Applications should include experience and education and other qualifications. Applications will be confidential.

Address CA-4127, % "Mechanical Engineering."

Engineers
wanted by
STANDARD OIL COMPANY (*Indiana*)

Mechanical, civil, and chemical engineers are needed for design and inspection work at Standard Oil Company's largest refinery located near Chicago.

Continuing expansion of facilities and technological advances create openings for qualified engineers. Recent graduates are desired, and are offered an opportunity to work and advance with one of the leading companies in an industry noted for its engineering achievements.

Engineering staff is permanent, with excellent opportunities for advancement and also promotional outlets to other departments of the Company. Positions are well-paying and outstanding employee benefit plans are provided.

The interesting variety of work includes inspection of existing oil refining units and of new facilities; also the design, construction, development and servicing of all types of oil refinery equipment. This includes power plants and distribution systems, water supply and waste disposal facilities, structures, buildings, heat exchangers, piping, fractionating and other process equipment used in the development and distribution of petroleum products.

Reply by letter, giving complete summary of education and experience and stating salary expected. All applications will be carefully considered and kept strictly confidential.

STANDARD

ADDRESS: Mr. P. L. Krauel
Chief Engineer, Whiting Refinery
Standard Oil Company
2400 New York Avenue, Whiting, Indiana

Eleven Pages of "OPPORTUNITIES"

North American encourages advanced thinking, because they know looking ahead is the only way to maintain leadership in the aviation industry. That's why North American needs men of vision. If you like hard thinking and would like to work for a company that will make the most of your ideas, you'll find real career opportunities at North American. North American offers you many extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Education refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

IS YOUR FIELD LISTED HERE ?

Airborne Electronic Equipment
Equipment Flight Tests
Precision Instruments
Automatic Controls
Propulsion Systems
Servo-Mechanisms
Airframe Studies
Radar Devices
Instrumentation
Micro Wave Techniques
Metallurgical
Electroplating
Engineering Planning

NORTH AMERICAN AVIATION, INC.

Aerophysics, Electro-Mechanical Research Division

Dept. 6, Personnel Section,

12214 Lakewood Blvd., Downey, California

North American Has Built More Airplanes Than Any Other Company In The World

CHIEF APPLICATION and DESIGN ENGINEER

Starting Salary to $8,000

...with extensive design experience in most of the following—centrifugal fans, axial flow fans, high pressure blowers, mechanical draft fans, pneumatic conveying equipment and dust collectors. He should be fully capable of producing designs at a competitive price, which when built and installed will perform to customers' specifications. Experience in writing technical literature for engineering and sales staff, and customers helpful.

All negotiations treated in strict confidence. Placement fee paid by the employer. If your qualifications match the above requirements, please write immediately, giving details of your personal, educational and business background and achievements, to

J. B. FRASER AND ASSOCIATES
Consulting Management Engineers
Executive Placement Consultants
Bank of Nova Scotia Building
Toronto, Canada

MECHANICAL ENGINEERS—STRESS ANALYSTS—HYDRAULIC AND SERVO SPECIALISTS

Research positions available with large machine tool company in an expanding research program. Engineers with expert experience in hydraulic control systems, servomechanisms and stress analysis needed. Individuals with aircraft design experience are particularly invited to explore the possibilities offered by these positions. Engineers with a sincere interest in making basic contributions to industrial productivity through a basic industry will find challenge and unusual opportunity here.

Address CA-4073, % "Mechanical Engineering."

METAL CUTTING RESEARCH

Mechanical Engineers and Physicists needed by large machine tool company for expanding program of basic and applied research on metal cutting, and on the grinding of metals treated as a metal cutting process. Here is an opportunity for original research in a virtually virgin field with a company well known for its research contributions to this field.

These positions offer unusual opportunity and challenge to individuals with a sincere interest in developing and applying new knowledge of a type that will benefit industry as a whole.

Address CA-4074, % "Mechanical Engineering."

Bearing and Lubrication Engineer

With a minimum of several years' experience in the theory and application of bearings and lubricants, for PERMANENT position with INTERNATIONAL BUSINESS MACHINES, Endicott, New York.

Should have an engineering degree or equivalent and experience in porous metal sleeve bearings, ball and roller bearings and lubricants as used in intricate high speed electro-mechanical devices.

Excellent living and working conditions, good salary, exceptional employee benefits, opportunity for professional development, moving expenses paid.

Write, giving full details including education and experience, to: Mr. E. H. Getkin, Coordinator of Engineering Recruitment, International Business Machines, Department 686 (5), 590 Madison Ave., New York 22, N. Y.

MECHANICAL ENGINEER

We need one experienced BS or MS Mechanical Engineer for design, construction and maintenance work in connection with bench scale and pilot plant research in coal processing. This position offers an exceptional opportunity for advancement both in research and in anticipated commercial fields. Replies including education, experience, references, salary desired and recent photograph should be directed to:

Pittsburgh Consolidation Coal Company
Research and Development Division
Library, Pennsylvania
Attention: William F. Saalbach
Adviser on Personnel

ENGINEER

With technical education and ten to fifteen years of experience in design and development of heavy machinery or similar experience, for research and development work both as to design and from industry study points of view. Permanent position with opportunities to grow are involved in expanded program of well-established heavy machinery, rolling mill and hydraulic press builders. Location Pittsburgh. Write complete details of experience pertinent personal information, and enclose photograph in first letter. Salary $7,000 to $9,000 per year, depending upon experience.

Address CA-4070, % "Mechanical Engineering."

MECHANICAL ENGINEERS

BENDIX RADIO will suit you to a "T"

We need Mechanical Engineers to work on design of small mechanisms, light structures, gear trains, chassis and packaging units as applied to electronics communications equipment.

Men we want must have M. E. or A. E. degree, with one or more years experience in mechanical design.

Positions involve board design, model shop association and construction-testing of primary models.

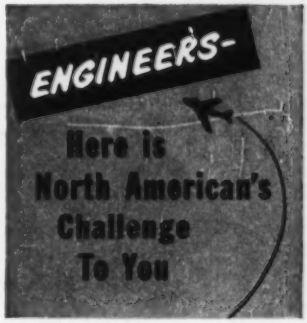
You benefit from excellent starting salary, ideal working conditions in modern plant, paid vacations and holidays and good chance for rapid advancement. Housing immediately available in beautiful suburban and country areas that surround the Bendix plant.

Write, wire or phone
MR. E. O. COLE, Dept. M

Bendix Radio
DIVISION OF BENDIX AVIATION CORP.
BALTIMORE-4, MD. Phone: TOWSON 2200

MAKE USE OF THE OPPORTUNITIES SECTION

If you desire capital or have it to invest; if you have a patent for sale or development, if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—use a classified advertisement in MECHANICAL ENGINEERING for quick results.



Frankly, working at North American requires hard thinking and plenty of vision. Because North American always works in the future. Yet, if you are interested in advanced thinking, if you'd like to work on the planes that will make tomorrow's aviation history, you'll like working at North American. North American offers these extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Educational refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

CHECK THESE OPPORTUNITIES AT **North American**

- Aerodynamicists
- Stress Engineers
- Aircraft Designers and Draftsmen
- Specialists in all fields of aircraft engineering
- Recent engineering graduates
- Engineers with skills adaptable to aircraft engineering

NORTH AMERICAN AVIATION, INC.
Dept. 6, Engineering Personnel Office
Los Angeles International Airport
Los Angeles 45, Calif.; Columbus 16, Ohio
North American Has Built More Airplanes Than Any Other Company In The World

In a career, just as in any journey, knowing when to make the right turn is of utmost importance. With 150 years of industrial leadership and achievement behind it, and a great expansion program ahead, Du Pont offers you an excellent opportunity for individual growth and technical achievement.

Consider seriously these vital factors and you will recognize the wisdom of turning to a Du Pont career:

STABILITY — 71 plants and 38 laboratories in 25 states;
DIVERSITY — 1200 Du Pont products serve industry and the consumer;
CHALLENGE — association with restless pioneering minds — vast research programs that have developed modern miracles like nylon, "Orlon" acrylic fiber, "Dacron" polyester fiber, neoprene chemical rubber, plastics;
ADVANCEMENT — a living Du Pont tradition that has seen engineers attain the majority of top executive positions in the company;
SECURITY — a company benefits program, unique in industry for its comprehensive coverage.

Should you be interested in turning to Du Pont, please send complete resume, including educational qualifications to:

Mr. T. J. Donovan

E. I. du Pont de Nemours & Co., Inc.

Engineering Department 116
Wilmington, Delaware

WANTED:
A TOP FLIGHT EDITOR

The man we're looking for is well seasoned in trade magazine editing. He's completely dependable and has his feet firmly on the ground. He's a graduate engineer and has worked for a few years, at least, as an industrial or consulting engineer. He has the ability and personality required to organize and supervise an editorial department and is able and willing to be a "working" editor.

If you possess these requirements, we have an opportunity which is sure to interest you. We're expanding our operations to include publication of a new magazine, "Consulting Engineer," and we're looking for a man capable of directing the editorial departments for both "Consulting Engineer" and "Industry and Power," a magazine which we've published for over thirty years. Salary is open and definitely in line with the importance of this job.

When applying, please give us, in your first letter, a complete resumé of your education and experience, tell us about your family and home, let us know why you think we should employ you for this position, and give us your salary requirements. If you have a photo or snapshot of yourself, send it along, too.

Please do not telephone or apply in person. We want to study all applications carefully. Your application will be treated in absolute confidence. Our employees know of this advertisement. Direct your application to A. M. Roe, Managing Partner, Industry and Power Publishing Company, 420 Main Street, St. Joseph, Michigan.

A LINK IN YOUR FUTURE

MECHANICAL DESIGN ENGINEERS

For engineers with experience in the design of small mechanisms, Link Aviation has an excellent opportunity.

Work involves design of newest flight simulators and forthcoming commercial products. Permanent position located in beautiful Southern Tier of New York.

Good housing available in suburban setting.

Ample company benefits.

Write full details to Manager of Industrial Relations.

LINK AVIATION, INC

DRAFTSMEN...

WHY IT WILL PAY YOU TO WORK ON NUCLEAR POWERED SHIPS

with Electric Boat in Groton, Connecticut
(Near New London, on Long Island Sound)

1. **OPPORTUNITY**—Pioneer in this great new field of today . . . get a head start on the unlimited potentialities it provides for tomorrow . . . with Electric Boat, designers and builders of the world's first atomic-powered submarines!
2. **STABILITY**—No draftsman has been laid off at Electric Boat in 20 years!
3. **HIGH WAGES**—Together with achievement and security, your high earnings provide a strong basis for satisfaction.
4. **RELAXATION**—Leisurely living in Groton, Connecticut, free from city pressures, within minutes of every recreational facility. Electric Boat will help you find housing.

ELECTRIC BOAT

Division of General Dynamics Corp.

GROTON CONNECTICUT

. . . with following experience:

ELECTRICAL, experience on marine or electronic circuits

MECHANICAL, knowledge of materials and mechanical processes

STRUCTURAL, knowledge of shipbuilding

PIPING, marine experience, or steam power plant, oil refinery or heavy chemical plant experience.

Clip This Handy Coupon Now! Application sent to you immediately.

Mr. P. J. Carpenter
Electric Boat Division, General Dynamics Corp.
Groton, Conn.

Please send me an application form for one of the profitable positions now open at Electric Boat.

Name .....

Address .....

City ..... State .....

DESIGN STAFF ENGINEER

Transmission

BROAD experience in precision automotive transmission design, including extensive background in manufacturing operations. Helicopter or aircraft experience desired. Responsible for transmission design at staff level; and, to coordinate design problems with vendor manufacturers. A degree in mechanical engineering is preferred. However, equivalent experience will be accepted.

DESIGN STAFF ENGINEER

Electrical

BROAD experience in aircraft electrical systems. Aircraft experience required. Experience in electronic systems including auto-pilot and radio desirable. Administrative ability and experience which will enable the individual to direct activities of a small design staff, coordinating all electrical and electronic activities within a large aircraft engineering department. Degree in electrical engineering preferred. However, equivalent experience will be accepted.

INDUSTRIAL ENGINEERS

INDUSTRIAL or mechanical engineering degree or equivalent, plus experience in analyzing manufacturing problems related to methods (direct and/or indirect), plant layout processing, tooling and cost reduction.

HELICOPTER TEST PILOTS

With not less than 250 Hours of Helicopter Time

A-l-s-o

DRAFTSMEN

With two to five years' experience, preferably in aircraft.

Send complete resumé, including salary requirements to EMPLOYMENT MANAGER

PIASECKI

Helicopter Corp.

Department "C"

Morton, Pa., A Phila. Suburb

FAST GROWING CHEMICAL PROCESSING COMPANY *in Western New York* NEEDS TECHNICAL MEN

WORKS ENGINEER

Age 30–40, Engineering degree—ME preferred. Equivalent to 5 years responsible maintenance experience in a chemical plant. Also, steam generation experience desirable. Must have congenial personality and ability to get along with subordinates. Complete responsibility as Works Engineer reporting directly to Production Manager. To direct and coordinate full programs in maintenance, power, material control and project engineering. This man will supervise approximately 45 men including 1 supervisor, 3 foremen, and 3 graduate engineers. Salary open

ALSO: Graduate Chemical and Mechanical Engineers. Age 20–30. Recent college graduates with industrial experience preferred. Men who apply should be capable of rapid advancement. Salary open.

Send complete resumés to

CA-4118 MECHANICAL ENGINEERING

29 W. 39th St., N. Y. 18, N. Y.

All Replies Strictly Confidential

TECHNICAL PERSONNEL

looking for

INCREASED RESPONSIBILITY

in

ENGINEERING
- PRODUCTION
- MAINTENANCE
- INSTRUMENTATION
- CONSTRUCTION LIAISON
- INDUSTRIAL ENGINEERING
- DESIGN AND DEVELOPMENT
- ARCHITECT-ENGINEER LIAISON

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investigate opportunities at our

ATOMIC ENERGY INSTALLATIONS

Send resume and request for detailed information concerning Openings, Company Policies and Community Life

TECHNICAL PERSONNEL OFFICE

CARBIDE AND CARBON CHEMICALS COMPANY

a division of

UNION CARBIDE AND CARBON CORPORATION

POST OFFICE BOX P, OAK RIDGE, TENN.

It will pay you to read the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

Eleven Pages of "OPPORTUNITIES"

AN OPPORTUNITY IN AIRPLANE DYNAMICS FOR ENGINEERS AND PHYSICISTS

Techniques applicable to flight airplane dynamic stability tests are being adapted to wind tunnel tests of four-foot span models. The need to expedite this assignment presents a challenge to the Mechanical, Civil Engineer or Physicist with training in vibration analysis.

An acceptance of the challenge presents the added opportunity to work with those solving aerodynamic and electronic instrumentation problems for this Air Force sponsored project.

Previous experience is not required. This is an excellent opportunity to enter the field of aeronautical engineering.

Cornell Aeronautical Laboratory, Inc.
4455 Genesee Street Buffalo 21, New York

MECHANICAL ENGINEER

Leading firm of Engineers, Designers and Construction require mechanical engineer having some experience with steam-electric central station design with specific and thorough experience on all phases of coal handling systems including unloading from rail or water, conveying, crushing, screening, distribution and sampling. Require general knowledge of capabilities and limitations of equipment commercially available. Initial work mainly on coal handling systems but must have ability to develop into well rounded general engineer capable of later handling all phases of central station design. State education, experience and salary desired.

Address CA-4095, % "Mechanical Engineering."

MECHANICAL ENGINEERS

We are looking for mechanical engineers, with experience in the design of small intricate mechanisms, to work in the development of business machines. Plenty of opportunities for advancement.

Write, giving full details, including education and experience.

THE NATIONAL CASH REGISTER CO.
South Main and "K" Streets
Dayton 9, Ohio

COAL STOKER MANUFACTURER of established product in the power plant industry has attractive opening for general office assistant sales manager. Splendid opportunities for advancement and permanent employment. Applicants must have had some similar previous experience as sales manager or salesman of mechanical stokers, power boilers, or allied products. Applications will be treated in strict confidence and should state age, education, previous experience, and other qualifications for employment described. Previous or present employers or other references will not be contacted without applicant's knowledge. Prompt confidential interview will be arranged with qualified applicants.

Address CA-4126, % "Mechanical Engineering."

Mechanical Designers Layout Draftsmen

For PERMANENT POSITIONS with

Endicott, N. Y. **IBM** *Poughkeepsie, N. Y.*

TRADE MARK

Excellent opportunities for designers and layout draftsmen with a minimum of five years' experience desirable in mechanism design. Assignments involve the design and layout of intricate high speed mechanisms and electro-mechanical devices at both the development and production engineering level.

Good salaries, unusual opportunities for professional development, exceptional employee benefits, excellent working and living conditions, moving expenses paid.

Write, giving full details, including experience and training, to: Mr. E. H. Getkin, Coordinator of Engineering Recruitment, International Business Machines, Dept. 686 (5), 590 Madison Avenue, New York 22, N. Y.

MAJOR APPLIANCES

PRODUCT DESIGN AND PRODUCT DEVELOPMENT MEN

General Electric Co.

We want capable men with several years of strong experience, who have proven their ability in our field or in similar lines. Appliance Park, Louisville, Kentucky will be the appliance center of the world and our rapid expansion here will provide wide open opportunity for many people in these positions.

Send resume to:

M. B. TRACY
GENERAL ELECTRIC CO.
310 W. LIBERTY STREET
LOUISVILLE 2, KY.

ENGINEERS

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE

Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

THIS IS NOT A
CIVIL SERVICE APPOINTMENT

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA *Corporation*

SANDIA BASE
ALBUQUERQUE, N. M.

SALES ENGINEER

Excellent opportunity in the home office of the Export Division of a major midwest manufacturer of heavy machinery for a man who knows power plant machinery and operation. Our employees know of this ad.

Address CA-4111, % "Mechanical Engineering."

INDUSTRIAL DRAFTSMAN

Experienced man for design of mechanical handling equipment, piping, plant layout, etc. This is not defense work and with a nationally-recognized manufacturer. Graduate ME or IE desired. In reply, state experience and salary expected.

Address CA-4108, % "Mechanical Engineering."

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For Consulting Engineers
Turn to Page 142

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POSITIONS OPEN

Eleven Pages of "OPPORTUNITIES"

Continued from Page 139

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Large research and engineering laboratory needs an engineer to assist in the planning and carrying out of methods and procedures for classifying, indexing, and disseminating technical information resulting from the Company's research program. Qualifications required are a Bachelor's Degree in Mechanical or Automotive Engineering, plus an interest in and aptitude for technical literature work. Some experience desirable but not essential. Ethyl Corporation, 1600 West Eight Mile Road, Ferndale 20, Detroit, Michigan.

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California Institute of Technology
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena 3, California

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TECHNICAL LIBRARIAN—Engineer with library experience or librarian with technical library experience to run established research library responsible for periodicals, books, laboratory notebooks and permanent filing. Midwest location. Address CA-4103, care of "Mechanical Engineering."

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Additional Opportunities are offered in the display advertisements— on pages 100, 113, 124, 128

DESIGNER—Experienced in design of variety of special small and medium size machines, *intricate* mechanisms and tools. Positions in research department on experimental and prototype equipment. Must have record of accomplished designs made on his own. Superior working conditions including medical and surgical plans, hospitalization plan, annuity plan and life insurance coverage equal to salary. Congenial co-workers. Eastern location. Available to metropolitan area. Salary $6,000 to $8,000. Address CA-4130, care of "Mechanical Engineering."

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DESIGNING DRAFTSMEN with experience in concrete or mill construction large Copper Company Chile, South America. 3-year contract. Transportation both ways and salary while traveling paid by company. In reply give complete details. Address CA-4142, care of "Mechanical Engineering."

ASSISTANT OFFICE ENGINEER recent electrical engineering graduate with some practical experience in office work and procedure, for work large Copper Company Chile, South America. 3-year contract, transportation both ways and salary while traveling paid by company. In reply give complete details. Address CA-4143, care of "Mechanical Engineering."

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"OPPORTUNITIES" Section This Month 131-141

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Registered Professional Mechanical Engineer, Massachusetts. Age 34. Extensive construction and maintenance experience. Desires to do sales engineering of mechanical accessories or heavy equipment. Well adapted for installation and service consulting. Located in New England.

Address CA-4113, % "Mechanical Engineering."

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ENGINEER—46, M.E., P.E., 25 years experience in design and construction of industrial process equipment; machine, electrical and structural design; industrial heating, drying and baking; ventilation, refrigeration and air conditioning; material handling, instrumentation and controls; purchasing, accounting, management and sales. Desires permanent responsible position with progressive firm. Address CA-4114, care of "Mechanical Engineering."

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MECHANICAL ENGINEER—27, MS, desires responsible position making use of 6 years' experience in plant engineering, research and process development. Background: food and beverage, textiles and synthetic fibers. Now employed. Address CA-4124, care of "Mechanical Engineering."

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If you are planning a development program on production machinery, I would like an opportunity to determine how my broad past experience could be of help to you in organizing and supervising such activity, or acting as consultant to your existing organization. Address CA-4147, care of "Mechanical Engineering."

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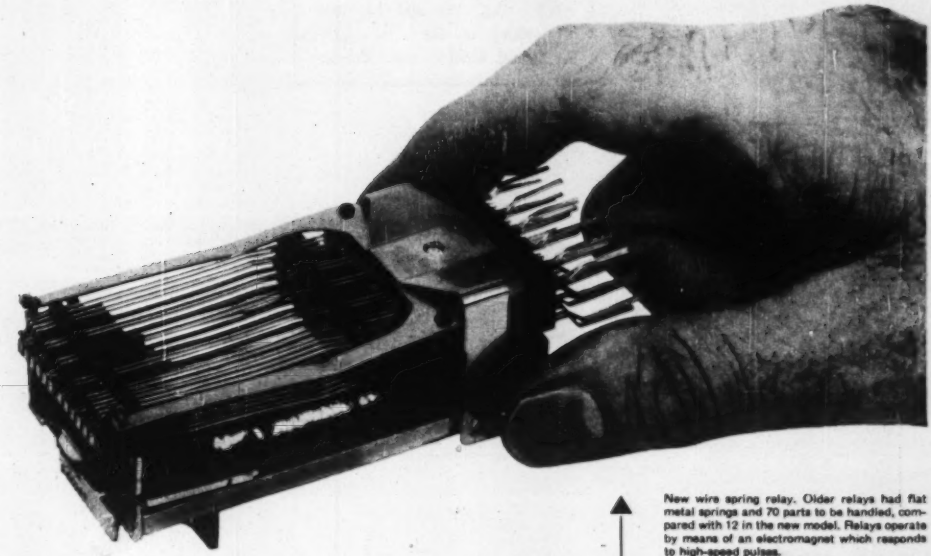
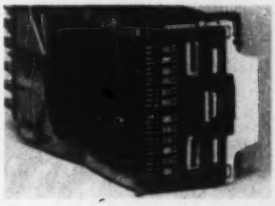


New wire spring relay. Older relays had flat metal springs and 70 parts to be handled, compared with 12 in the new model. Relays operate by means of an electromagnet which responds to high-speed pulses.

In a split second, relays, which are high-speed switches, set up dial telephone connections. Then they are off to direct the next call. Yet even this speed is too slow for Bell Laboratories scientists in quest of still faster switching.

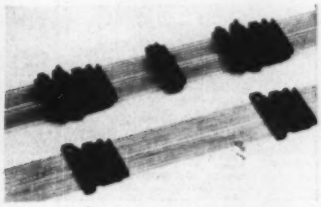
Scientists and engineers devised a new relay – the wire spring relay – and worked out the production problem with Western Electric, manufacturing unit of the Bell System. This is twice as fast, uses less power and costs less to make and maintain.

With speedier relays, switching can be done with less equipment . . . and calls go through faster. The wire spring relay is a practical example of how Bell Telephone Laboratories and Western Electric pool their skills to improve telephone service while keeping its cost down.



New relays must be able to operate one billion times—equal to once-a-second for 30 years. Employing a sound recorder as a precision vibrator, Bell scientists learned to evaluate the effect of sideways motion on relay life. Such rubbing motion is limited to one-thousandth of an inch in the new relays.

Dynamic Fluxmeter, developed by Bell Laboratories, indicates flux build-up in intervals of 25 millionths of a second. Precise information like this was essential to higher speed operation.



Relay springs as they come from Western Electric molding machine, before being cut apart for use. Molding technique saves time and money . . . makes possible the maintenance of precise adjustment.

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Zurn, J. A., Mfg. Co. 117

The asterisk indicates that firm also has product catalog in the 1953 ASME Mechanical Catalog and Directory

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Myers & Addington
National Weld Testing Bureau
Nuclear Development Assoc.
Palmer, Delos M. & Assoc.
Polachek, Z. H.
Sanderson & Porter
Sargent & Lundy
Sirrine, J. E., Co.
Stanley Engineering Co.
Tour, Sam & Co.

Advertisers in Previous 1952 issues but not in this issue

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Jensen Specialties, Inc.
*Aetna Ball & Roller Bearing Co.
*Air Preheater Corp.
*Allis-Chalmers Mfg. Co.
American Flexible Coupling Co.
American-Fort Pitt Spring Div.
H. K. Porter Co.
*American Manganese Bronze Co.
American Pencil Co.
*American Pulverizer Co.
Amplex Mfg. Co., Div. of Chrysler Corp.
Anderson, V. D., Co.
*Armstrong Machine Works
Automotive & Aircraft Div.
American Chain & Cable Co.

*Babcock & Wilcox Co.
*Barco Mfg. Co.
*Bigelow Co.
Bigelow-Liptak Corp.
*Bin-Dicator Co.
Boston Gear Works
Brownell Co.
Brush Development Co.
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Industrial Truck Div.
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*Cochrane Corp.
Cone-Drive Gears Div.
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Coxhead, Ralph C. Corp.
Cuno Engineering Corp.

*Detroit Stoker Co.
Diefendorf Gear Corp.
*Downingtown Iron Works
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*Koppers Co., Elex Precipitator

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Posey Iron Works (Inc.)
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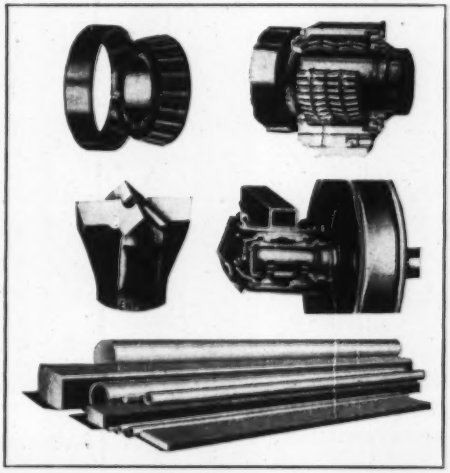
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